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## PRIZE-DRIVEN INNOVATION FOR DEVELOPMENT

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# EXECUTIVE SUMMARY

## I. The Grand Challenges of Development

We face today an array of **developmental challenges** in energy and the environment that **compromise the well-being of billions of people and the health of the planet itself**. A variety of market and system failures - ranging from externalities to public goods to a lack of purchasing power to behavioral failures to a lack of social mobilization - inhibit innovation and breakthroughs in crucial areas.

## II. Prizes: A Proven and Promising Tool for Development

Our research suggests that **innovation prizes** -- a proven and increasingly popular tool -- can provide **incentives** to solve **key developmental challenges** in areas **where market signals are weak or non-existent**.

In brief, **innovation prizes** (also called incentive prizes or inducement prizes) are a **species of results-based financing**. They set a **specific** and usually **objectively measurable target *ex ante***, can rally a **global cadre of innovators** for a **dramatic competition**, and provide a **cash purse** (that can be significant and highly publicized) **only upon the achievement of the desired result**. Prizes also provide **substantial investment leverage** by inducing an investment by competitors that can in aggregate **far exceed the purse**. Prizes can capture the **public imagination** and **focus attention on a problem**. We focus here on **large-scale incentive prizes**, as distinct from the numerous recognition prizes (such as the Nobel Prize, which are based on retrospective qualitative evaluations) and idea contests (such as business plan contests, where the goal is to submit a proposal or an idea). McKinsey and Company in a major 2009 study on prizes concluded that “**prizes are a unique and powerful tool that should be in the basic toolkit of many of today’s philanthropists.**”

The prize model arguably came to prominence in 1714 when the British Parliament created the Longitude Prize, which spurred the creation of the marine chronometer and enabled modern navigation. Prizes range in the current era from the X PRIZE Foundation’s **\$10M Ansari X PRIZE** for suborbital space flight, which spurred the creation of the private space flight industry, and the \$10M Progressive Insurance Automotive X PRIZE for a 100 mpg-equivalent car, to the **Indian Government’s current Nirmal Gram Puraskar**, which has been **awarded to over 25,000 villages, with a total population of over 50 million people, for meeting goals in sanitation**.

**Today, the use of large-purse prizes is growing rapidly**, roughly tripling according to the McKinsey study over the 2000-2009 period. Prizes are increasingly supported by many national governments and leading corporations (e.g., Google, Virgin). **Incentive prizes are well-established in the energy, environment, and development spheres, with prizes of up to US\$25M having been offered in India, China, across Africa, the US, and the UK**, in a variety of fields, over the past two centuries.<sup>1</sup>

While prizes are a powerful tool, they work best when there is a clear, objective goal, and many participants who are willing to bear risks. The research, design, and planning process for prizes is critical, and can take a year for a single prize. Assembling a good group of experts and involving communities and stakeholders is also important to the successful design and execution of a prize.

### III. Stakeholder Support and Views

**We have found a strong enthusiasm for innovation prizes in development** through our “Visioneering” workshops for senior leaders, thinkers, and field experts in Delhi, stakeholders from large institutions in New York, and with innovators from outside the development field in Los Angeles. As **Andrew Steer**, the **special envoy for climate change at the World Bank**, said at the New York meeting, “At the Bank, we feel that **this type of instrument is actually a winner ... this is an idea whose time has come.**” Stakeholders expressed their keen support for pursuing prizes in three spheres: **business, social, and technology innovation.**

The notion of the innovation chain, which stretches from idea generation at the beginning of the chain, to the achievement of impact at scale at the end, was discussed. A recent report commissioned by DEW Point/DFID found that while prizes can and have been successfully offered at any point in the chain -- from business plan contests at the beginning, to large-scale incentive prizes at the end -- there are far fewer prizes at the end. Participants at the New York workshop felt that the greatest opportunity lay at the end of the innovation chain, which is also where the development need is greatest.

The prize model works in the **development space** by **providing incentives** and publicity in areas of market or system failure to an **array of key actors** (e.g., technology entrepreneurs, researchers, corporations, data miners and algorithm developers, villages, citizens, and even heads of state), to elicit **important break-**

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<sup>1</sup> See Knowledge Ecology International, “Selected Innovation Prizes and Reward Programs,” (Research Note, 2008:1), and the compilation of prizes described therein. See also the recent DewPoint/DFID Report, “Evidence Review - Environmental Innovation Prizes for Development,” (2011), authored by Bryony Everett, which contains case studies of several significant prizes. Large efforts include the Government of India’s Nirmal Gram Puruskar, with an estimated more than US\$25M in purses awarded to date, and the US Department of Energy’s Hydrogen Prize program, with \$50M in authorized purses.

**throughs** and **through deft pairings with other programs** (e.g., advanced market commitments, and national programs or campaigns). Prize purses can be awarded to a single winner, shared by all who meet a threshold, or given to thousands via a distributed micro-prize, where a single purse or honor is shared among legions of winners.

In the Delhi workshop and afterward, a number of **prize concepts** were suggested for possible further exploration, including notions in:

- off-grid lighting and charging,
- distributed sanitation solutions,
- scaled village-level renewable energy systems,
- drinking water,
- biofuels with no food tradeoff,
- low carbon building materials,
- participation/energy efficiency prizes enabled by metering,
- cross-sectoral mobilization around district or national level MDG achievement,
- cleaner business processes, and
- super energy-efficient household appliances (such as fans).

Descriptions of those concepts are attached to this report.

For greatest effectiveness, prizes for development should also be situated as a key element of a larger, coordinated innovation process. The idea of a **prize “platform”** bringing together **a variety of players**, to perform the following **functions**:

1. **needs analysis,**
2. **prize design and operations, and**
3. **enabling impact at scale**

**was mooted and supported** at the Delhi and New York meetings. Participants also noted that the prize and surrounding processes **must involve communities**, and could enable much-needed (but almost non-existent) **collaboration between diverse groups**.

Participants also discussed the principles of an **institutional arrangement** that might support a series of prizes in development. They felt that the effort should be **independent, residing outside of governmental and multilateral systems; nimble and entrepreneurial; and based in a developing country, albeit with a global reach**. Other suggestions were to assemble a strong board, with leaders from the entrepreneurial and social sectors, and to have a geographic focus that might include the Indian subcontinent or Sub-Saharan Africa. Nearly all the stakeholders expressed a strong interest in being involved in such a program as it moves forward, with one emphatically stating that whatever the final shape of an activity that might be put together along such lines, “[my organization] would want in,” and many others concurring.



## PROJECT OVERVIEW

In this project, DFID asked the X PRIZE Foundation, in collaboration with the Indian Institute of Technology Delhi, to conduct an inquiry into using innovation prizes to address developmental challenges. The focus was to be on environmental issues, broadly defined, so as to encompass energy, water, forestry, and other subjects. The principal activity was to be the convening of two workshops, one in India and one in the US, to assess the interest of stakeholders and to garner their input. The first workshop was to draw upon field experts, and was to be spent in large part generating preliminary notions for prizes that might be pursued. The purpose of the second workshop was to gauge interest from large stakeholder organizations in pursuing a series of such prizes, and to garner opinions on principles for an appropriate institutional arrangement, if such an endeavor were to be pursued. We agreed to provide a report of 20 pages after the workshops, which report was envisioned as the work of “one person for one week.”

X PRIZE Foundation and IIT-Delhi conducted the two workshops, one in Delhi and one in New York. Contributing their own resources on an honorary basis to the project, X PRIZE and IIT-Delhi also performed the following additional work: conducting four three-hour workshops in Los Angeles, creating a series of posters of “prize concepts” stemming from the Delhi workshop, and writing a formal report on the New York workshop.

The first workshop was held at IIT-Delhi, and included a slew of experts and leaders with PhDs and deep field experience from the NGO, government, and private sectors. Participants included Ajay Mathur, the Director General of the Government of India’s Bureau of Energy Efficiency, Nisha Agrawal, the CEO of Oxfam India, Sunita Narain, the Director General of the Center for Science and Environment, and Shan Mitra of DFID. The second workshop was held at UNICEF headquarters in New York City. Participants included Andrew Steer, World Bank Special Envoy for Climate Change, Dan Kammen, World Bank Chief Technical Specialist, Renewable Energy and Energy Efficiency, Janos Pasztor, Secretary of the UN Secretary General’s High Level Panel on Global Sustainability, David Ferguson, of USAID, Michael Myers, Senior Policy Officer, Rockefeller Foundation, Stephen Mills and Peter Ndunda of the Greenbelt Movement, and Bryony Everett, representing DewPoint/DFID. The Los Angeles workshops were part of the X PRIZE Foundation’s organization meetings, attended by its trustees, including Ratan Tata (Chairman, Tata Group), Eric Schmidt (Chair, Google), inventor Dean Kamen, and other board members. Participants included Sonal Shah, head of the White House Office of Social Innovation, Jay Naidoo, Chair of GAIN, and others. We do hope that the workshops, surrounding conversations, associated reports, and this document have been and will be of some help in fostering the understanding of prizes at DFID and in the larger community.



# PRIZE-DRIVEN INNOVATION FOR DEVELOPMENT

## 1. Development Challenges and Market and System Failures

A range of impediments -- market and systemic failures and barriers -- prevent us from effectively meeting developmental challenges. These include impediments that constrain the supply of new technologies and other innovations that could make a positive contribution to human and social development and those that limit the translation of these innovations into practical application and large-scale diffusion:

- *Classic market failures such as those involving public goods (and avoidance of negative externalities (i.e., 'bads'))*

Public goods are defined as being non-excludable (i.e., one cannot exclude others from enjoying these goods) and non-rivalrous, where enjoyment or consumption by one person does not reduce the availability of a good to others. Given these characteristics of public goods, private players cannot profit from supplying these goods and therefore have little incentive to invest in these areas. This leads to a situation of underinvestment by private firms in these areas - with the notion of underinvestment construed in relation to what might be expected or needed with regard to the problems. Governments can fill the gap to some extent, as happens with publicly-funded energy, environment, and health research and technology development programs.

- *Customers with limited purchasing power (BoP)*

Progress on some major development challenges – providing energy, water, sanitation to the poor – is impeded by the fact that members of the target group have limited financial resources and therefore are unable to purchase available but high-priced goods and services that would serve their needs. In many cases, the lack of a consolidated market serves as a disincentive to private players to focus on the needs of this group. In fact, much of the global S&T (science and technology) enterprise is driven principally by market demand. Consequently, efforts to tackle developmental challenges affecting billions of people are incommensurate with the vast scale of the problems (e.g., the 90-10 divide in biomedical research, which suggests that 90% of R&D is targeted to problems affecting 10% of world's population).

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<sup>1</sup>The enormous numbers of these consumers, though, led the management guru C.K. Prahalad to highlight the potential of the aggregated demand of this group (see *The Fortune at the Bottom of the Pyramid: Eradicating Poverty Through Profits*, Wharton School Publishing 2004).

<sup>2</sup>In most of the countries that are major R&D performers (10 countries account for about 80% of the global R&D), the business sector is the major funder and performer of R&D. (Science and Engineering Indicators 2010, National Science Foundation, Washington DC, USA, 2010)

<sup>3</sup>See *The 10/90 Report on Health Research 1999*, Global Forum for Health Research, 1999.

Furthermore, the scale of S&T enterprises of developing countries (which, in principle, would have the greatest motivation to tackle developmental challenges) is much smaller than that of industrialized countries, both because of their lower GDP and lower R&D expenditures as a proportion of GDP. In 2007, for example, OECD countries accounted for over 80% of the total estimated global R&D expenditure of \$1.1 trillion.<sup>4</sup> While the major emerging economies such as Brazil, China, and India have large S&T systems and even strengths in specific technology areas, their technological capabilities are still relatively limited – and most other developing countries fare even worse. Additionally, most developing countries often have much weaker policies, institutions, and markets as well as general financial and other resource constraints. As a result, their innovation systems, on average, are not as well developed as most industrialized countries. Even countries such as Brazil, China, and India, which have made significant strides in recent years, still lag well behind industrialized countries on indicators of technological/innovation capabilities and performance.<sup>5</sup> This, in a sense, is not surprising: the experience of developing countries has shown that acquiring and building the capabilities that foster technological dynamism and innovation is a slow and difficult process (although not impossible).<sup>6</sup>

- *Technology translation barriers or ‘valley(s) of death’*

There are two major financing gaps, often referred to as “valley[s] of death,” that impede the translation of technological opportunities, often leading to the demise of technologies (and sometimes even firms) that are unable to overcome these gaps. The first gap is at the early stage of innovation where funds are required to go from the proof of concept to product (see Figure 1.1). Generally research funds (from public sources or from internal sources in the case of private firms) are sufficient to demonstrate the technical feasibility of a concept; but support for translating the proof of concept to a working prototype is relatively limited. Public research and public funding agencies cannot justify the development of a prototype since it is seen as a commercial activity and for private funders. Private firms demur due to an excess of technical risk and the lack of a business case at this stage.<sup>7</sup> In fact, private funders (such as venture capitalists) generally are interested only when a prototype has been developed and demonstrated.

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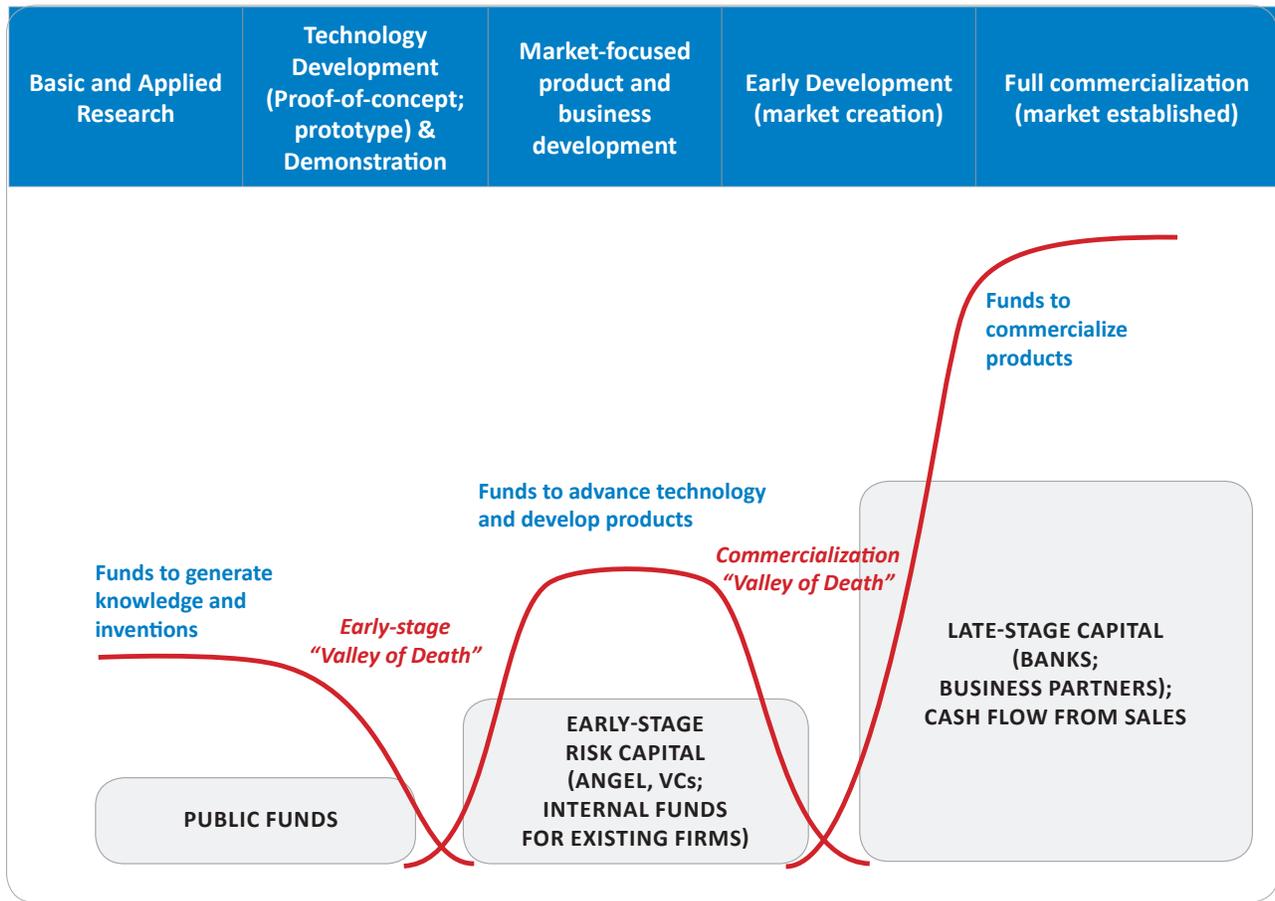
<sup>4</sup> Science and Engineering Indicators 2010, National Science Foundation: Washington, DC, USA (2010).

<sup>5</sup> The Global Innovation Index, for example, which attempts to assess the innovation performance of countries based on a range of indicators, ranks China 43rd, India 56th, and Brazil, 68th (Global Innovation Index, 2009-10, INSEAD: Fontainebleau (2010)); UNIDO’s Competitive Industrial Performance Index rates China as 26th, Brazil as 28th, and India as 54th (UNIDO Industrial Development Report 2009, UNIDO: Vienna (2009)).

<sup>6</sup> See, for example, A.H. Amsden, *Asia’s Next Giant: South Korea and Late Industrialization*, Oxford Univ. Press: New York, USA (1989); S. Lall, *Building Industrial Competitiveness*, OECD: Paris (1990); J.L. Enos, *The Creation of Technological Capability in Developing Countries*, Pinter: London, UK (1991); and L. Kim, *Imitation to Innovation: The Dynamics of Korea’s Technological Learning*, Harvard Business School Press: Cambridge, MA, USA (1998).

<sup>7</sup> See, for example, *Between Invention and Innovation An Analysis of Funding for Early-Stage Technology Development*, NIST GCR 02–841, US National Institute of Standards and Technology, Gaithersburg, MD (2002).

Figure 1.1: ‘Valleys of death’ in innovation stages



Source: Ambuj Sagar

The second “valley of death” refers to a later stage where significant funds are needed to establishing facilities for commercial-scale manufacturing of a product. At this stage, there still remains some market risk since there is no guarantee that the product will be attractive to consumers.

- *Information and trust*

There may be a lack of publicly available or trustworthy information about the improved performance attributes of a new product or service. In fact, to adopt new options, consumers must have information and confidence about them in relation to the status quo. This is particularly true in cases where the consumers are individuals who do not have the technical wherewithal to make a careful assessment of an option, weigh its merits and risks against existing options, and then make a decision. This may be as true of improved lighting as new agricultural practices.

- Market organization*

A technology or product may not have access to appropriate marketing/distribution/servicing channels. In many cases, this becomes a “chicken-and-egg” problem because an innovator may not have resources to build up a distribution or service network until the innovation has been taken up by sufficient customers. In other cases, there may be a lack of alignment of incentives between various actors in the innovation ecosystem. A classic example is from the building sector where a builder does not have much incentive to invest in energy-efficient technologies since the buyer or renter is rarely willing to pay a premium for this improved performance.
- Finance*

In many cases, a new innovation may be beneficial economically or otherwise and the potential consumer may even be aware of these benefits, but he/she may not have the financial ability to pay its higher up-front costs. The consumer in this case could be an individual or even a small firm who does not have access to credit.
- Human or institutional capabilities*

The successful deployment of new innovation may require labor with appropriate training or skills. It may be difficult, for example, to implement construction technologies and techniques for climate-proofing buildings if skilled labor is not available. Similarly, in the case of agriculture, providing training and information to farmers is crucial so that they can use the new practices or technologies (such as high-yielding or high-nutrition varieties, herbicide-tolerant crops, or low-input approaches) appropriately. The absence of such actors (individual or organizational) that fulfill key roles in the innovation chain may greatly impede the innovation process. Conversely, the presence of actors that fill specific gaps (such as energy-service companies) can facilitate innovation.
- Infrastructure needs*

Appropriate supporting infrastructure, such as the availability of steady electricity supply or cellphone network coverage, may not exist or may not be available in appropriate geographical areas. And in some cases, the maintenance infrastructure for new technologies may not be available.
- Inappropriate policies and regulations*

Sometimes policies and regulation (or lack thereof) may impede the diffusion of innovations. For example, the absence of policies that incorporate environmental externalities places renewable energy at a disadvantage to fossil fuels, even though the latter has much higher environmental and health impacts. Conversely, policies and regulations can also be used to promote desirable innovations, such as the case of renewable portfolio standards or feed-in tariffs or even environmental regulations.

- *Behavioral or governance failures*

In many cases, the barriers may be even more fuzzy. Behavioral or cultural barriers, for example, may impede the diffusion of a valuable service or technology (as in the case of villagers in Uttar Pradesh in India that are opposed to the delivery of polio drops for their babies).

- *Failures of social coordination or political will*

In other cases, a failure of social coordination or political will is a key deficit. For example, while there has been significant progress with regard to the MDGs and related goals, the advancement has been uneven and several MDGs may go unmet. There are multiple needs: to further elevate the MDGs in the hierarchy of financial and political priorities; to have better, larger, more coordinated, and more urgent efforts; to generate broader public awareness, drama, and excitement; and to mobilize multiple sectors around these goals.<sup>8</sup>

In light of the above failures, programs and activities aimed at leveraging the power of innovation must understand the gamut and nature of barriers specific to each application/challenge area, as well as the context of application, which may vary widely among regions and countries. Successful innovation, in fact, requires careful attention to the understanding of various aspects of the challenge/problem being addressed, i.e., the needs, capabilities, constraints, and preferences of the desired beneficiaries. It then requires the development of the innovation that could effectively address the challenge. And then, of course, it requires the design of a delivery program that overcomes the relevant barriers and challenges that may exist (and are identified) – these could include issues that are specific to the users (such as lack of information or finance), specific to the innovation (e.g., infrastructure needs), or that reside at a systemic level. As illustrated in the remainder of this report, prizes, operating singly or in complement with other strategies, can spur innovation to address these failures.

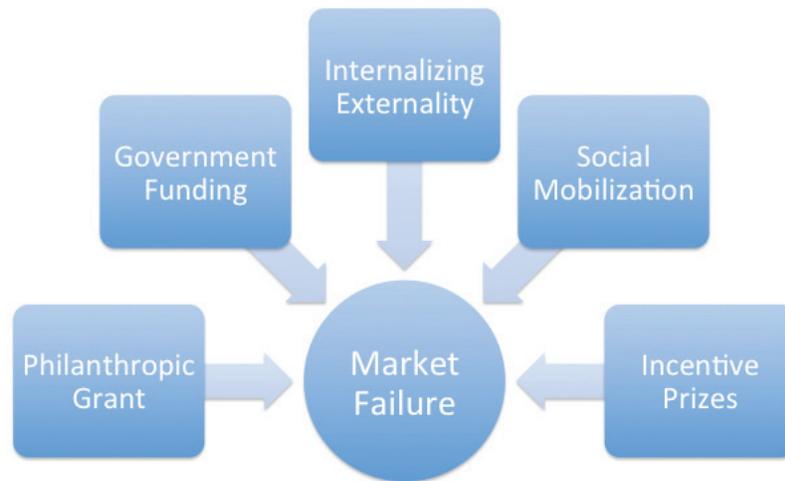
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<sup>8</sup>It is interesting to note that both the MDGs and the targets of an incentive prize are intended to be, in X PRIZE parlance, “objective, measurable, audacious, and yet achievable.”

**2. Prizes, Incentives, and Market Failures: Prizes can provide needed incentives in areas where market signals are weak or non-existent.**

Faced with a series of developmental challenges afflicting billions of people in areas of widespread market and systemic failures, and a resultant relative paucity in innovation, what means does a society have? In areas where market signals are weak or relatively non-existent, there are only a few available interventions, as illustrated below.<sup>9</sup>

**Figure 2.1 Mechanisms of Intervention in Areas of Market or System Failure**



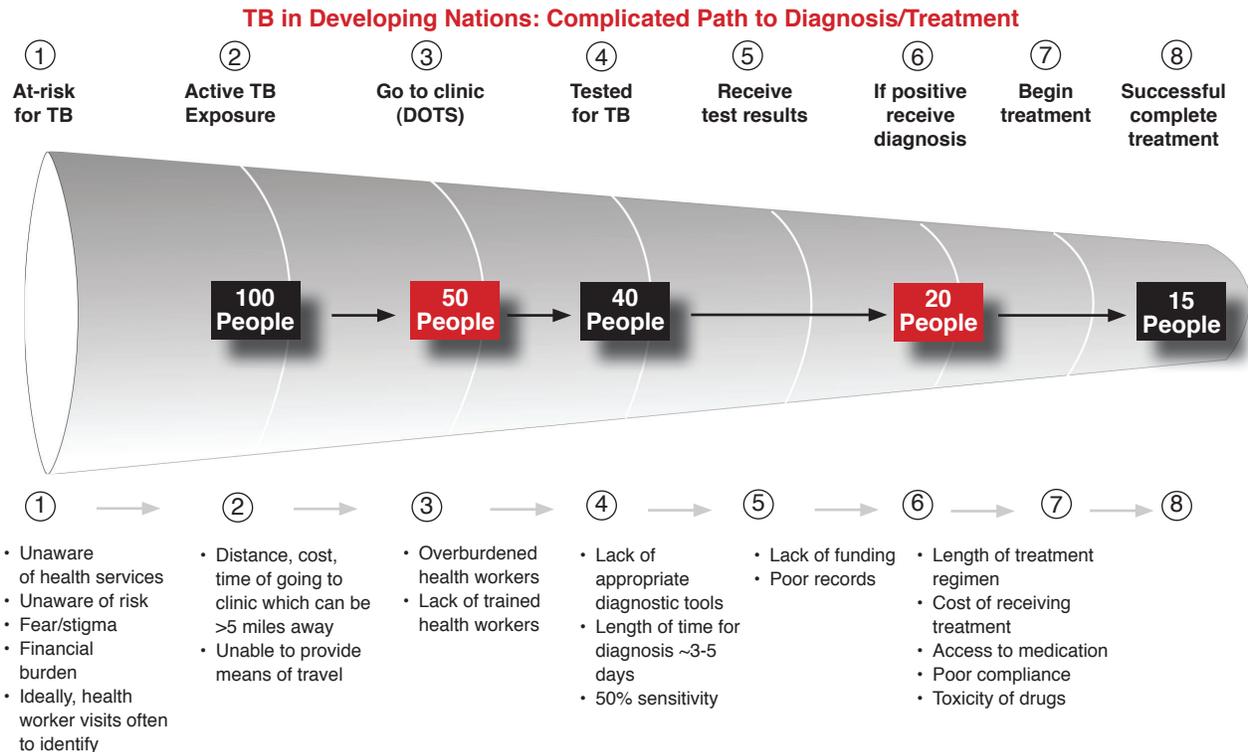
Options for addressing market failures clearly include philanthropic grants, as well as government funding, whether in the form of grants, R&D funding, direct payments to individuals, or subsidies. They also include removing externalities via actions such as regulation or legislation. Another option, although one might not call this a mechanism, is social mobilization itself, including citizen’s movements. What is posited here and in the innovation literature is that the incentive prize model is an additional method that can be deployed in areas of market failure. Given the relatively limited options and the vast scale of the problems, the availability of such an additional tool becomes critical.

The relationship between prizes and types of market or system failures is highly context specific. For a given class of market failure or for a given general subject matter, or even for a highly specific failure or challenge within a targeted area, a number of prizes can be designed. In other words, for a given problem,

<sup>9</sup> At an even higher level, one might say that a government funder has a choice between pull mechanisms (such as prizes or advance market commitments, as discussed in the text at footnote 15, *infra*) and push mechanisms (such as grants), or alternatively, although perhaps not exactly co-extensively, between results-based and non-results based funding. Governments also can act in their regulatory capacity, to correct market imperfections and internalize externalities, and can also of course use the “bully pulpit” to promote ideas.

one can attack it at several points, using for example a business strategy “funnel analysis”<sup>10</sup> as shown below, describing tuberculosis diagnosis and treatment. At each point there can be a number of different possible prizes, so the mapping from problem to prize is not one to one, but rather one to many.

**Figure 2.2 Tuberculosis Funnel Analysis**



**Access to health clinics and low diagnostic sensitivity are the largest impediments to diagnosing and treating TB in developing nations.**

A comprehensive survey of every market or system failure present in development, or of the array of specific failures within one of them, or of the many possible prizes that could address a specific failure, is beyond the scope of this paper. That is the work of the prize design process, which requires six months to a year to develop ways to address a single problem. Prizes in a way are analogous to grants – and to map out a general strategy for using grants is a large and perhaps futile task. But illustratively, we can show how some prizes or prize concepts have been or might be used to address some broad general classes of failures, just to provide a suggestion of the widespread applicability of this tool.

<sup>10</sup> For a discussion of funnel analysis, see “The Consumer Decision Journey,” McKinsey Sales and Marketing Practice, McKinsey Quarterly (June 2009). [http://www.mckinseyquarterly.com/Strategy/Strategic\\_Thinking/The\\_consumer\\_decision\\_journey\\_2373](http://www.mckinseyquarterly.com/Strategy/Strategic_Thinking/The_consumer_decision_journey_2373)

**Figure 2.3. A broad array of market and system failures may be addressed through incentive prizes<sup>11</sup>**

Type Of Market Or Other Failure	Illustrative Subject Matter	Prize Example
Classic microeconomic market failure: externalities	<p>Low carbon energy (carbon-intensive energy underpriced due to externalities)</p> <p>Pollution remediation (concentrated costs and diffuse benefits)</p>	<ul style="list-style-type: none"> <li>• \$25 MM Virgin Earth Challenge</li> <li>• \$1.4 MM Wendy Schmidt Oil Spill Clean-Up X CHALLENGE</li> <li>• Village-level renewable energy</li> </ul>
Classic microeconomic failure: public goods	Security threats	<ul style="list-style-type: none"> <li>• Asteroid deflector prize</li> <li>• Disaster warning systems</li> </ul>
Classic microeconomic failure: oligopoly	Automotive industry (entrenched players not innovating)	<ul style="list-style-type: none"> <li>• \$10 MM Progressive Automotive X PRIZE (100MPGe cars)</li> </ul>
Failure of imagination	Private space flight	<ul style="list-style-type: none"> <li>• \$10 MM Ansari X PRIZE</li> </ul>
Lack of actual or perceived purchasing power; orientation toward the perceived technological frontiers; “valley of death”	Vast array of necessary/useful products for the global poor	<ul style="list-style-type: none"> <li>• Lighting Africa prize</li> <li>• Cookstoves X CHALLENGE</li> <li>• Tuberculosis Diagnostics X CHALLENGE</li> <li>• Gov’ts of Bangladesh/Barbados/Bolivia/Surinam tuberculosis diagnostics prize</li> <li>• Open Source/Computational Biology Drug Design X CHALLENGE</li> </ul>
Timeframe failure	Cross-cutting - any area in which markets may ultimately achieve the goal but not in a desired timeframe	<ul style="list-style-type: none"> <li>• \$2 MM Northrup Grumman Lunar Lander X CHALLENGE</li> </ul>
System failure	Lack of social coordination around achievable goals	<ul style="list-style-type: none"> <li>• MDG prizes</li> <li>• NGP village total sanitation prize (25,000 villages received awards to date)</li> <li>• Social mobilization prizes (e.g. shoreline cleanup)</li> </ul>
Behavioral failures	Demand-side areas	<ul style="list-style-type: none"> <li>• Water/energy conservation prizes</li> <li>• Nutrition education</li> </ul>

<sup>11</sup> The rightmost column shows both prizes that have been launched and prizes that are in the concept or planning stages. The launched prizes are indicated by the display of purse or awardee information.

As the above table illustrates at a high level, prizes can be used to spur innovation in a variety of areas of market or systemic failure, ranging from classic microeconomic failures (such as externalities and public goods), to failures of imagination, to even behavioral failures. For example, to address the negative externality produced by carbon-based fuels (namely, that the cost of the pollution generated by those fuels is borne by third parties, external to the transaction, resulting in rampant greenhouse gas emissions), one might offer a prize for extracting greenhouse gases from the atmosphere (e.g., the Virgin Earth Challenge), or a prize for more fuel-efficient building materials (which would be of equivalent strength, weight and durability as existing materials but produced with less GHG emissions per unit). Another major type of market imperfection is public goods, whose provision involves concentrated costs but diffuse benefits. In the areas of disaster response or prediction, for example, one might offer prizes for improved algorithms to work with the “Big Data” that is becoming available. The best algorithm for predicting natural disasters, or finding the best algorithm for poring through demographic information to find correlations and identify communities where children need de-worming,<sup>12</sup> would win. Oftentimes markets are inhibited either by oligopoly, or by historical path-dependencies, and are as a result simply “stuck.” An example here is automobile manufacturing, where the large incumbents, who possess the needed distribution and service channels, have been slow to pursue the creation of highly fuel-efficient vehicles. The Progressive Automotive Insurance X PRIZE, awarded to the developers of 100 mile per gallon-equivalent cars, targeted that failure, creating a new set of ultra-efficient vehicles, as well as popularizing a new metric, MGPE (“miles per gallon equivalent”), which has since been adopted by the US EPA. Another type of failure might be simply a failure of imagination. In the case of private space flight, the component technologies largely existed, but an important reason for the lack of an advance was a failure of imagination, or a lack of sufficiently widespread belief that the goal was possible and worth pursuing, which was a deficit addressed by the Ansari X PRIZE for private space flight. The underserved market of billions of people comprising C.K Prahalad’s “bottom of the pyramid” (BoP) can be considered another system failure, albeit perhaps not a classic microeconomic failure. An extra pull in the form of a prize can be useful to creating affordable products for those consumers, so as to overcome issues such as valleys of death, the limited purchasing power, or an unfamiliarity on the part of producers with such markets. With regard to what might be called a “time frame failure,” even when all the necessary ingredients are present or close to present, a prize can serve to accelerate innovation and achieve targets more quickly than the markets left alone would have done, as was the case with the oil spill cleanup prize, where participants stated that the prize accelerated their pace of development. Prizes are also useful to address what might be called general “system failures.” In the case of the MDGs, for example, specific and supposedly achievable targets have, laudably, been set, but political and economic will and urgency have been lacking, and the means for achieving those goals have been thin. An “MDG Olympic” prize for national or subnational achievement, overlaid on top of the MDGs or related efforts, by setting deadlines and providing a sense of drama could provide a badly needed

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<sup>12</sup> Interview with Professor Rachel Glennester, MIT Poverty Action Lab, June 2010.

dose of publicity and galvanization.<sup>13</sup> The Nirmal Gram Puraskar prize in India, for village, block, and district level achievement in sanitation, has been an effective vehicle for social mobilization. It has been awarded to 25,000 villages thus far, with an estimated total population of over 50 million people.<sup>14</sup>

In addressing these failures, prizes serve as a means to induce, or to “pull,” innovation. In this respect they are akin to advanced market commitments,<sup>15</sup> although prizes usually have a lower level of funding. However, because prizes inherently utilize a crowdsourcing<sup>16</sup> approach, they often cast their net more widely. One can say that a prize “helps the needle in the haystack find you.” (Further, prizes can be used in the area of social innovation, whereas AMCs have been limited to products.) Lastly, we should note that the pull mechanism of prizes can be deployed either on its own, or as a complement to other pull mechanisms such as advance market commitments, or in conjunction with “push” mechanisms such as government or foundation grants.

### **3. Incentive Prizes, Past and Present: Incentive prizes have been used for centuries to spur the attainment of specific targets.**

Broadly speaking, there are two types of prizes – the recognition prize and the incentive prize.<sup>17</sup> Recognition prizes, such as the Nobel Prize, are typically awarded based upon a retrospective evaluation, using judicial discretion and subjective criteria. Incentive prizes set up a specific, often objectively measurable, target ex ante, as well as a competition to meet that target. The prize purse is awarded to the team or teams which first meet the target, or which perform the best as of a certain date.

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<sup>13</sup> Preliminary interest in such an idea – a global Olympic-style prize based on indicator achievement/improvements at a national level - has been expressed by several persons and groups, including Dr. David Nabarro, Special Representative of the UN Secretary General for Food Security and Nutrition, the MDG Health Alliance, Professor Jeffrey Sachs, the Gates Foundation, and the Children’s Investment Fund Foundation.

<sup>14</sup> See Everett Report Case Studies at 39, placing the figure at 120 million. This estimation might be high. It is based on the fact that approximately 10% of panchayats have been awarded the NGP. Given a total population of India of 1.21b as per the 2011 census, one arrives at a total population covered by the NGP-winning villages of 10% of 1.21b, or approximately 120 million. But as panchayats are village governing bodies, they would likely not include urban populations or persons living in rural areas outside of villages. As 68.8% of India lives in rural areas (as per provisional results of 2011 census, [http://censusindia.gov.in/2011-prov-results/paper2/data\\_files/india/Rural\\_Urban\\_2011.pdf](http://censusindia.gov.in/2011-prov-results/paper2/data_files/india/Rural_Urban_2011.pdf)), a figure of 80 million people (1.21b x .688 = 84M) may be more appropriate, or to very be conservative, and to account for those living in rural areas outside panchayats, 50M people. More research into NGP and Indian census data is necessary.

<sup>15</sup> Advance Market Commitments, or AMCs, entail a legally-binding promise by parties to purchase a product once it has been developed. They are a way to stimulate innovation and research and development. See, e.g. Gates Foundation, Advance Market Commitments for Vaccines Fact Sheet, detailing a \$1.5 billion AMC. <http://www.gatesfoundation.org/vaccines/Documents/amc-fact-sheet-2009.pdf>

<sup>16</sup> Crowdsourcing has been defined as “the practice of obtaining needed services, ideas, or content by soliciting contributions from a large group of people and especially from the online community rather than from traditional employees or suppliers.”<http://www.merriam-webster.com/dictionary/crowdsourcing>, visited December 23, 2011.

<sup>17</sup> A quick note on typology: The McKinsey report, describing both recognition and incentive prizes, speaks of “six prize archetypes”: Exemplar, Exposition, Network, Participation, Market Stimulation, and Point Solution. The Everett report describes Innovation Awards, Open Innovation, Social Challenges, and Market Stimulation Prizes. Other typologies or categories have been proffered as well. We will not propose a new schema here, other than to focus on large-scale incentive prizes, defined broadly. Large-scale incentive prizes would include prizes that lie within Everett’s Market Stimulation and the Social Challenge categories, as well as prizes within the McKinsey’s Participation, Market Stimulation, and Point Solution categories.

Incentive prizes range from idea or business plan contests, in which the product of the parties is a concept or proposal, to large-scale incentive prizes, in which a party must achieve a significant real-world result specified ex ante in order to win. In this report we will focus principally on the large-scale incentive prize, and when we use the phrase incentive prize, we will be referring to the large-scale incentive prize.<sup>18</sup>

There is lengthy precedent for the use of prizes. As noted by McKinsey,

Prizes have a long history that includes many examples of award-driven change. For centuries, they were a core instrument of sovereigns, royal societies, and private benefactors alike who sought to solve pressing societal problems and idiosyncratic technical challenges.<sup>19</sup>

National governments have embraced prizes for centuries. The incentive prize arguably first came to prominence through an action of the British government.<sup>20</sup> In 1714, the British government, by an Act of Parliament, offered a prize of £20,000, or roughly £2,000,000 in today's money, for a solution that could determine longitude to within half-a-degree (2 minutes of time).<sup>21</sup> The goal, on a major issue of the day and, according to one commentator, 'the greatest scientific problem of the age,'<sup>22</sup> was achieved by John Harrison, a clockmaker with little formal education, and his inventions led directly to the creation of the marine chronometer.<sup>23</sup>

In 1810, nearly a century after the offering of the Longitude Prize, Napoleon awarded a prize for food preservation. Although originally designed to help Napoleon's army, the basic technique is still used today to preserve food.<sup>24</sup> From 1839-1939, the Royal Agricultural Society in Britain awarded 1,986 prizes for agricultural innovation.<sup>25</sup> In 1927, Charles Lindbergh, age 25, and previously an unknown, made his historic non-stop flight across the Atlantic in response to a prize offered by New York hotelier Raymond Orteig. In

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<sup>18</sup> Other common terms are "inducement prize" or "innovation prize" – they will be used as synonyms in this report.

<sup>19</sup> McKinsey & Company, "And the winner is... Capturing the promise of philanthropic prizes," (2009) (hereinafter, "McKinsey report"), at 15.

<sup>20</sup> The earliest widely cited prize, however, is the Spanish Longitude Prize, offered in 1567 by King Philip II of Spain, of a reported 6000 gold ducats, for the discovery of a method for finding longitude at sea. See, e.g. Knowledge Ecology International, Selected Innovation Prizes and Reward Programs, KEI Research Note 2008:1, at 35.

<sup>21</sup> "John Harrison and the Longitude Problem," National Maritime Museum, <http://www.nmm.ac.uk/harrison> (visited November 25, 2011)

<sup>22</sup> See Sobel, Dava, Longitude, The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time, Penguin (1996)).

<sup>23</sup> "John Harrison (1693–1776) and Lt. Cdr. Rupert T. Gould R.N. (1890–1948)," Jonathan Betts, Senior Specialist, Horology National Maritime Museum, excerpt at <http://www.nmm.ac.uk/upload/pdf/Gould-Harrison-longitude-JBetts.pdf> (visited November 25, 2011) at 5-6)

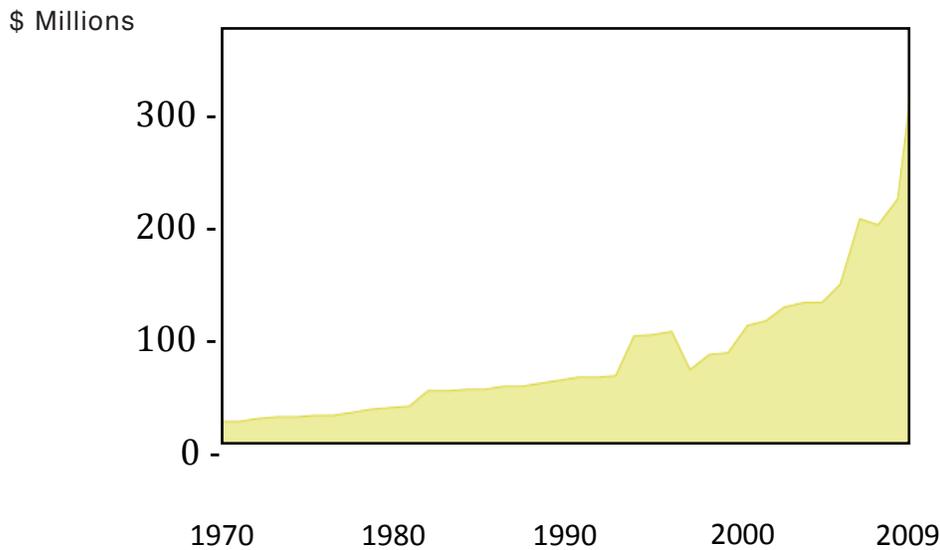
<sup>24</sup> McKinsey & Company, "And the winner is... Capturing the promise of philanthropic prizes," 2009.

<sup>25</sup> Inducement Prizes and Innovation," Liam Brunt, Josh Lerner, Tom Nicholas, Harvard Business School Working Paper 11-118 (2011). Prizes were central to the Society. One of its founding objectives was "...by the distribution of prizes and any other mode of expending a part of the resources of the Society, to encourage men of science to exert themselves in the improvement of agricultural implements. Id. at 3.

aggregate the competitors spent \$400,000 pursuing the \$25,000 prize purse, for a leverage factor of 16.<sup>26</sup> Lindbergh pursued an approach – a solo flight on a single engine plane - eschewed by the incumbents, who used multiple engine crafts carrying several people.

In recent times, according to a 2009 McKinsey report, the aggregate purse for large scale prizes roughly *tripled* over the preceding ten years, and increased *15-fold* over the preceding 35 years. The same report estimates that the total prize sector was worth \$1 - \$2 billion in early 2009.<sup>27</sup>

**Figure 3.1: Growth in Large-Scale Prizes**  
**Aggregate Prize Purses (prizes over \$100k)<sup>28</sup>**



Source: “*And the Winner is...?: Capturing the Promise of Philanthropic Prizes,*”  
McKinsey & Company, March 3, 2009

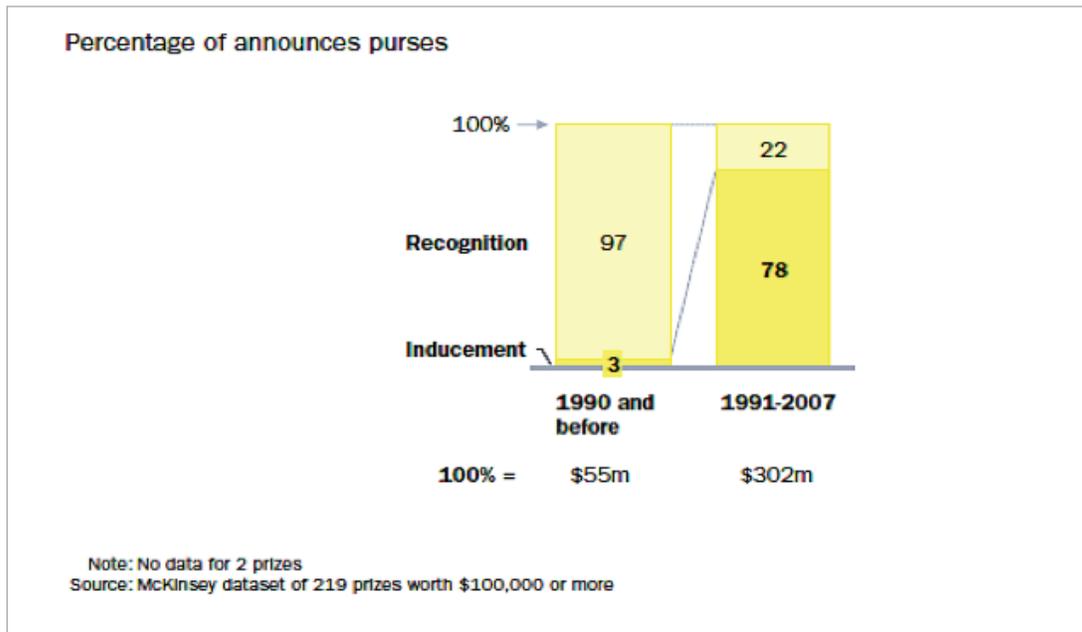
Incentive prizes are also growing rapidly in relation to recognition prizes, as found in the McKinsey study.

<sup>26</sup> Lindbergh: *Flight’s Enigmatic Hero*, Von Hardesty and Erik Lindbergh (Harcourt, New York, 2002) at 15; “Prizes for Innovation in African Agriculture: A Framework Document,” Will Masters (2006) at 9.

<sup>27</sup> McKinsey report at 16.

<sup>28</sup> McKinsey report at 16.

Figure 3.2: Incentive Prizes vs. Recognition Prizes



Prior to 1991, 97% of the value of large purses went to prior achievements such as the Nobel Prize. After 1991, 78% of large purses went to incentive prizes for a specific future goal.<sup>29</sup> We are thus in an era of rapidly growing use and acceptance of incentive prizes.

#### 4. Development Prize Examples: Prizes have been used in the area of development over the past two centuries.

The use of incentive prizes in the development sphere is also well-established. The prizes listed thus far have been in all areas and have been offered to show the proven nature of the prize model. In the examples below, we focus on prizes in development. While we have not undertaken a value for money analysis of these prizes, many of the below were found to deliver significant value for money, as detailed in the Everett report, the Knowledge Ecology International report<sup>30</sup>, and other sources.

The examples below include:

- 1) Prizes that have been based in or offered by entities in developing countries,
- 2) Prizes that have been offered in developed countries but have focused on developmental questions in the global South,
- 3) Prizes that have been offered in the areas of energy and the environment, and
- 4) Older prizes in the global North, during its times of early industrialization, that addressed classic developmental questions such as hunger, agricultural productivity, and energy access.

<sup>29</sup> McKinsey report at 17.

<sup>30</sup> Knowledge Ecology International, Selected Innovation Prizes and Reward Programs, KEI Research Note 2008:1 (hereinafter, "KEI report").

We have focused, although not exclusively, on large scale incentive prizes (ex ante prizes aimed at producing a significant real world result), as opposed to recognition prizes or idea contests. Examples of past and current prizes, organized by nation of origin, include<sup>31</sup>:

### **Brazil**

- UNICEF Seal of Approval program (1998-present?)
  - Villages meeting targets linked to child wellbeing and the MDGs are allowed to obtain, bear and renew a UNICEF Seal.<sup>32</sup> According to a project review by UNICEF, “the strategy of incentivizing entire communities as a whole rather than operating sector/vertical specific programs appears to be promising.”<sup>33</sup>

### **Burkina-Faso**

- Burkina-Faso Innovation Prizes (1994- present?)
  - Sponsored by the national government; prizes typically offered every other year for solutions in varying development themes, such as desertification, water, and poverty; prizes are posed for specific problems, but do not appear to have ex ante targets.

### **China**

- China CFC-Free Energy-Efficient Refrigerator Project (1999-2005)
  - Funded by the GEF, the prize component was part of a broader strategy for disseminating energy-efficient refrigerators. A \$10M GEF investment in the program generated \$30M in corporate finance in pursuit of the prize.<sup>34</sup>
- Cookstoves prize sponsored by the government of China (2006-2007)
  - Prize given to the highest performing cookstoves (including emissions standards for health and the environment) on the market).<sup>35</sup>

### **India**

- Indian Government Prizes for Decorticating China Grass (1869)
  - Prize of £5,000 for a machine that could separate the fiber from the stems and bark of freshly cut china grass (rhea), considered key to the development of commercially successful textile products.

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<sup>31</sup> Many of the below listings are drawn from the KEI report.

<sup>32</sup> The indicators include infant mortality rates, improved pre-natal care, greater access to quality education and other indicators measuring the quality of children's and adolescents' lives.

<sup>33</sup> Project Review: The UNICEF-Municipal Seal of Approval, Ceara, Brazil,” [http://www.childfriendlycities.org/pdf/brazil\\_ceara\\_full-document.pdf](http://www.childfriendlycities.org/pdf/brazil_ceara_full-document.pdf). See also “UNICEF Municipal Seal of Approval,” <http://www.selounicef.org.br/?op=1&k=2> (visited November 25, 2011).

<sup>34</sup> See Everett report at 119.

<sup>35</sup> Interview with David Pennise, Berkeley Air Monitoring Group, which helped design the program, in October 2011.

- Government of India's Nirmal Gram Puraskar (2003-present)
  - For achievement in sanitation. 25,000 villages, and additional blocks and districts, have won to date, with a total population of over 50 million people. Awards are highly publicized and very popular, with ceremonies taking place in stadiums, and having been presented by the President of India. States tout their achievements in advertisement in daily newspapers. Sanitation coverage in India has increased 7-8% annually since the launch of the NGP, as opposed to 3% annually during the Total Sanitation Campaign prior to the launch of the NGP.<sup>36</sup> Purse sizes range from Rs 50,000 (approximately US \$1,000) to Rs 500,000 (approximately US\$10,000). At more than 25,000 awardees, that means more than \$25M in prize purses have been awarded. The actual figure may be significantly higher – the total expenditure for 2011 alone for the program has been estimated to be US\$20M.<sup>37</sup>

### **France**

- Académie de Besançon Prize for Substitute Foods (1771)
  - For discovering a vegetable that could be used in times of famine; winner proposed the use of the potato, then unknown in France, and later popularized its use there.
- Napoleon's Food Preservation Prize (1795)
  - For a method of preserving food, so that Napoleon's troops could be fed abroad if food were unavailable; led to the development of canned food.
- Napoleon III Margarine Prize(1869)
  - Offered by Napoleon III for discovery of a process to manufacture a butter substitute. Aimed at the problems of a growing urban population and rising price of butter; margarine invented in response to prize.
- Breant Prize for Asiatic Cholera (1854)
  - 100,000 franc endowment was administered by the French Academy of Sciences. Goal, unrealized, was a cure for Asiatic Cholera; interest on the endowment awarded in annual prizes to researchers who made the greatest contributions.
- Francois Joseph Audiffred Prize for a Tuberculosis Remedy (1896)
  - 24,000 francs offered by Académie de Médecine of Paris for a curative or preventive remedy for tuberculosis.

### **Italy**

- Italian Prize Competition in Irrigation Practice (1869)
  - Prize competition for executed works of irrigation or drainage announced by King of Italy.

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<sup>36</sup> Everett report at 26.

<sup>37</sup> Everett report, Case Studies at 39. The total expenditure on the program since inception, including purses, evaluations, and award ceremonies, is estimated by Everett to be US\$120M.

## United Kingdom

- Substitute for Guano Prize (1852)
  - £1000 offered by the Royal Agricultural Society, for discovery of manure equal in fertilizing properties to Peruvian guano, and available in unlimited supply to English farmers for £5/ton. Part of century-long (1839-1939) series of prizes offered by Royal Agricultural Society, which made 1,986 awards.<sup>38</sup>
- NESTA Big Green Challenge (2007)
  - CO<sub>2</sub> emissions reduction through community innovation; £1M purse.
- Saltire Prize (2007)
  - Wave or tidal stream energy technology; sponsors are the Scottish Government and The National Geographic Society; £10M purse.

## U.S.

- Super Efficient Refrigerator Program (early 1990s)
  - US\$30MM incentive offered by US utilities for manufacturer who could develop CFC-free refrigerators using 25% less energy and not exceeding prevalent market price; sponsored by US utilities.
- Rockefeller Prize (1994)
  - \$1M prize offered by the Rockefeller Foundation for low cost diagnostic for chlamydia and gonorrhoea for use in the developing world; offered in 1994 and expired in 1999 without a winner; critiqued according to KEI as being too small and offered for too short a period.<sup>39</sup>
- Grainger Challenge (2005)
  - US\$1M prize from the National Academy of Engineering for groundwater arsenic removal systems for use in developing countries.
- Virgin Earth Challenge (2007)
  - US\$25MM prize for extracting CO<sub>2</sub> from the atmosphere in a commercially viable manner.
- New Options Petroleum Energy Act (2007)
  - Proposed bill in US Congress that included a provision for a \$1 billion prize for the first US car manufacturer to sell 60,000 gasoline-powered, mid-sized sedans that achieve 100 miles per gallon; provision did not pass.
- H-Prize (2007)
  - \$50M in prize purses to be awarded by the Department of Energy between 2008 and 2017 to advance the commercial application of hydrogen energy technologies.<sup>40</sup>

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<sup>38</sup> The RAS prizes are the main subject of “Inducement Prizes and Innovation,” Liam Brunt, Josh Lerner, Tom Nicholas, Harvard Business School Working Paper 11-118 (2011).

<sup>39</sup> KEI report at 27.

<sup>40</sup> KEI Report at 20; and [www.hydrogenprize.org](http://www.hydrogenprize.org) (visited Dec 21, 2011)

- Progressive Insurance Automotive X PRIZE (2008)
  - For ultra-fuel efficient cars achieving 100 miles per gallon equivalent; \$10M purse awarded in 2010, with the US Department of Energy providing a \$3.5M grant for associated education.
- Wendy Schmidt Oil Spill Clean-Up X CHALLENGE (2010)
  - US\$1.4MM ocean oil-spill cleanup prize, awarded in 2011.

### **Africa-wide**

- Mo Ibrahim Prize for Achievement in African Leadership
  - US \$5M+ for heads of state of African nations who step down in accordance with the constitution at the end of their terms.

### **Global**

- GEF Earth Fund
  - Fund intends to use a mix of tools such as grants and “inducement prizes”;<sup>41</sup> in 2008 the Fund contemplated, along with IFC, a Biofuels Prize Initiative.<sup>42</sup>
- MDG Awards
  - For exemplary contributions in meeting the Millennium Development Goals. Award is made by a panel, and is not for actually meeting the MDGs at scale.

## **5. Benefits of Incentive Prizes: The incentive prize approach has a number of benefits due to its results-based and open structure.**

Incentive prizes have a number of benefits, particularly from the perspective of a funding agency.

First and foremost, incentive prizes provide financing on a *results-only* basis. The prize purse is awarded if, and only if, the target is achieved. This feature differentiates the prize approach starkly from grants and most equity investments. This sort of approach can be considered a species of the “results-based financing” that is gaining currency in government and development agency circles.

Secondly, prizes provide *investment leverage*. In an era of limited and shrinking government and philanthropic budgets, this is increasingly important. A well-constructed prize can magnify the funders’ investment, as the competitors in aggregate can spend many times the amount of the prize purse. As the motivation for the competitors is often beyond the pecuniary – the pursuit of a lofty goal, the attendant publicity, and proof of their performance are often key considerations – significant multiples can be achieved. In the case of the Orteig Prize won by Lindbergh, the competitor spent in aggregate 16 times the purse. In the

<sup>41</sup> <http://www.thegef.org/gef/PPP>

<sup>42</sup> May 7, 2008 Letter from GEF to Council Members, [http://www.thegef.org/gef/sites/thegef.org/files/documents/earth-fund-PIF\\_0.pdf](http://www.thegef.org/gef/sites/thegef.org/files/documents/earth-fund-PIF_0.pdf)

\$10M Ansari X PRIZE, the competitors reportedly invested \$100M. In the Nirmal Gram Puraskar and the UNICEF Seal, the purse amounts are relatively small or zero, respectively, but create large effects due to the prestige of the award.

Further, the leverage is not limited to the immediate expenditures of the parties during the course of the competition. A prize can have effects long after the prize competition is over. This can take the form of creating new industries, altering trajectories, creating new infrastructure, protecting planetary health, saving lives, and increasing human productivity through the enhancement of health. With regard to the Ansari X PRIZE, for example, investments in private space flight went from trifling before the competition to nearly \$100 billion in aggregate afterwards. A purse of \$10 million thus spawned a competitor expenditure of \$100 million and subsequent investments of nearly \$1 billion.

Third, the prize approach is *pathway agnostic*. Traditional funding mechanisms require the identification of promising approaches and promising recipients. In the prize model, only the end result is prescribed, and not the approach. This openness allows for the psychological, social, and network biases that favor incumbent parties and conventional wisdom to be more easily overcome.<sup>43</sup>

Fourth, prizes attract a *broad cadre of innovators*. Most incentive prizes are open to teams from around the world. As per Joy's Law, reportedly coined by Sun Microsystems co-founder Bill Joy, "no matter who you are, most of the smartest people work for someone else." The top performers in prize competitions are often not the dominant parties in the field, but outsiders and unknowns. In the Goldcorp Prize, for example, the owner of a gold mine in Canada posted the mine's previously-confidential data on the web, offering a prize to the group that could most accurately predict the most profitable places to extract gold.<sup>44</sup>

The winning team was composed of two small firms from Australia. The leader of one had never been to Canada.

Fifth, prizes attract *public attention*. Prizes can educate, inspire, and even mobilize the public; they are

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<sup>43</sup> Examples of novel approaches include Harrison's time piece approach to the longitude problem, Lindbergh's single engine plane, and the openness of indicator-oriented prizes such as the NGP and the UNICEF Municipal Seal of Approval, in which most any approach that achieves the desired result is permitted.

<sup>44</sup> In 2000, [Goldcorp] abandoned the industry's tradition of secrecy, making thousands of pages of complex geological data available online, and offering \$575,000 in prize money to those who could successfully identify where on the Red Lake property the undiscovered veins of gold might lie. Retired geologists, graduate students and military officers around the world chipped in. They recommended 110 targets, half of which Goldcorp hadn't previously identified. Four-fifths of them turned out to contain gold. Since then, the company's value has rocketed from \$100m to \$9bn, and disaster has been averted.

"The Wiki Way," September 4, 2007, <http://www.guardian.co.uk/technology/2007/sep/05/news.netrich> (visited November 29, 2011)

dramatic and focus global attention on an issue, and can change the paradigm of what is possible. The Ansari X PRIZE created literally billions of media impressions, and served as the cover story for national and international magazines such as *Time*, *Wired*, *Popular Science*, and *Philanthropy*. Apart from brute media impressions, it also arguably changed the paradigm of what is possible – namely, that space was not the sole province of sovereign governments, and could be reached with the smaller budgets available to entrepreneurial private players. In the development context, creating more publicity -- which is often a necessary precursor to creating increased political will -- regarding problems of the relatively powerless and voiceless could have a transformative impact. Critical problems such as sanitation, for example, which are fundamental to human well-being, suffer from a dearth of publicity. Simply shining a spotlight on such problems, and helping them get the attention they deserve, can move them higher up in the hierarchy of societal priorities. A challenge, of course, is that some issues are, perhaps, not readily telegenic or media friendly. They may involve dry technical issues, or have very long time frames. But through clever prize design, one can often place a human face on these issues,<sup>45</sup> and craft a sense of drama.

Sixth, prizes open up *new forms of collaboration*. At the New York workshop, there was a strong and broadly shared view that the intellectual and discussion-rich and yet outcome-driven, hard-edged approach embodied by prizes could open up new collaborations between organizations, of which there is a paucity. It was noted that there exists a disincentive for organizations to collaborate, given the competition for funding and publicity. Promoting collaboration between a range of actors from various areas and various sectors (academia, large and small private firms, bilateral and multilateral agencies, governments and foundations) may itself be seen as one of the desired outcomes of the award, and therefore integrated into the prize design. This could, for example, take the shape of several oft-competing organizations collaborating on a prize, or by requiring each competing team to have cross-sectoral participation, being for example comprised of a community group or NGO paired with a private sector group.<sup>46</sup> As a participant noted, “we almost need a prize for a new way of working together.” But it was also recognized that organizations are more used to competition than collaboration, so the tension between these will need to be managed. However, in the end, if one is able to build collaboration, it may have long-term gains in terms of capacity-building -- and as another participant noted, “capacity-building may be more valuable than technology.” In fact, if the prize is centered on an important issue, and is able to bring together key players, and excite them, that itself is a big move forward.

Seventh, prizes can articulate and reify new *metrics* and *standards*. The mile-per-gallon-equivalent

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<sup>45</sup> In the Archon Genomics X PRIZE, for example, which seeks to create rapid and affordable ways to sequence human genomes, the technologies will be tested on 100 centenarians.

<sup>46</sup> This was the suggestion of the international division of the US Department of Housing and Urban Development, in conversations about a possible X PRIZE for inclusive and sustainable housing. Conversations with Stewart Sarkozy-Banoczy, Director, Philanthropic Research & Initiatives, Office for International and Philanthropic Innovation (IPI), US Department of Housing and Urban Development, and colleagues, July 2011.

(“MPGe”) standard, for example, was used by the Progressive Insurance Automotive X PRIZE, and provides a simple way to judge the efficiencies of engines powered by gasoline, electricity, or other means by a single standard. It has since been adopted by Consumer Reports and the US Environmental Protection Agency.

Lastly, with the *democratization of access* to powerful technology and communications media, and the increased availability of sophisticated vendors and other resources, the crowd-sourcing so effectively elicited by prizes will be an increasingly powerful force.

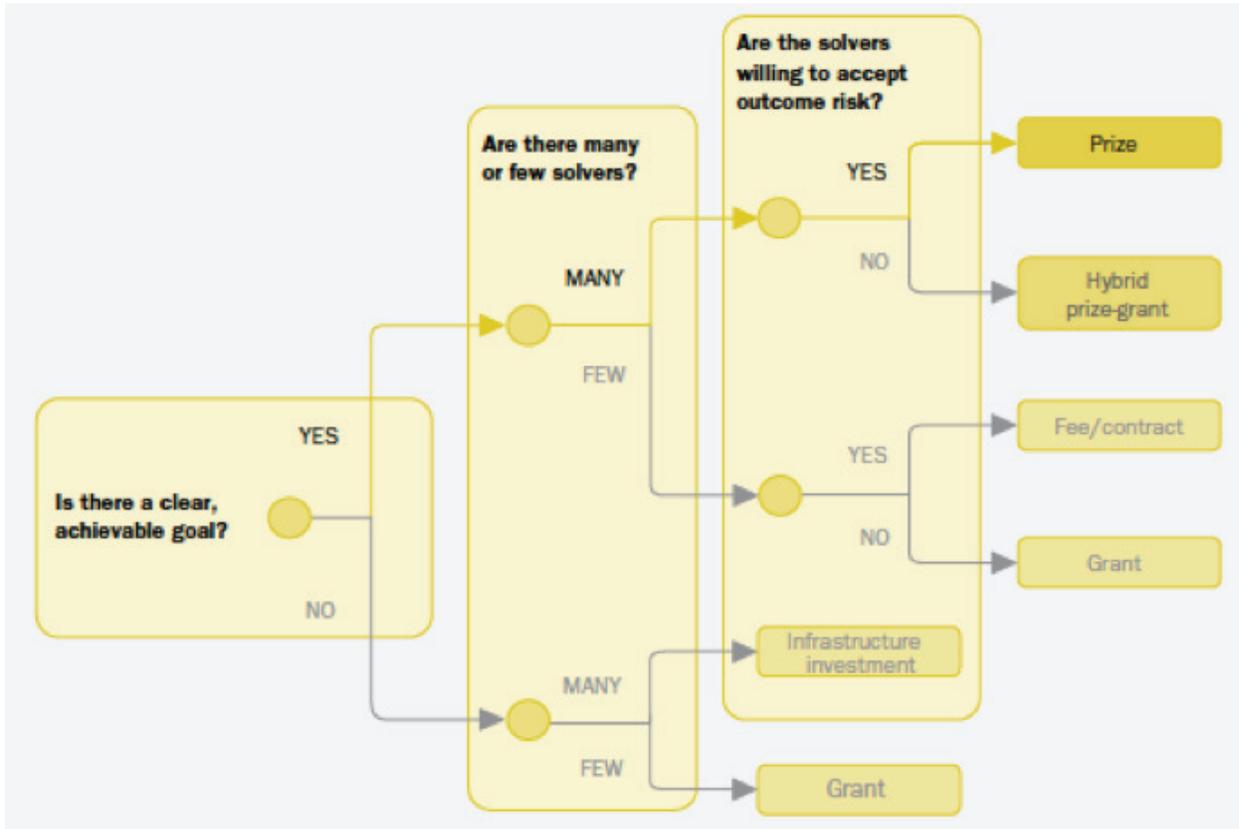
## **6. When to Use Prizes: Incentive prizes are best used when there are clear, objective goals, with many participants who are willing to bear risks.**

Prizes are not a universally applicable mechanism. Finding value in the prize approach does not render other approaches suspect – prizes in fact can work very well in complement with other strategies. But as the below chart from McKinsey illustrates, prizes work best in situations where there are clear, objective goals, with many participants who are willing to bear risks.<sup>47</sup>

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<sup>47</sup> One might query whether prizes are truly generating new innovation. Conceivably, the objection goes, those innovations might have come about regardless of the prize. In recognition prizes, that is indeed likely the case. However, incentive prizes present a very different scenario, where the causation is often very clear. Incentive prizes, nearly by definition, induce new or at the least accelerated actions by parties. Competitors must register at the outset, participate in the events, and typically mount new or faster efforts specifically in response to the prize. Examples include the Ansari X PRIZE for suborbital space flight, which essentially forged a new field, and the recently won Wendy Schmidt Oil Spill Clean-Up X CHALLENGE, in which the winner created and implemented a novel “capillary” approach in response to the prize. The broader literature on innovation supports this view. As many scholars contend, prizes do indeed accelerate innovation. See, e.g. “Inducement Prizes and Innovation,” Liam Brunt, Josh Lerner, Tom Nicholas, Harvard Business School Working Paper 11-118 (2011)(hereinafter, “HBS study”), noting that “a long-standing argument in the literature on incentives for innovation suggests that prize awards can be a powerful mechanism for accelerating technological development (e.g., Polanyi, 1944; Wright, 1983; Kremer, 1998; Shavell and Ypersele, 2001; Scotchmer, 2004; Boldrin and Levine, 2008; Kremer and Williams, 2009; Chari et al., 2009).” Id. at 3. The HBS study performed a historical analysis of prizes offered by the Royal Agricultural Society over a 100 year period and concluded that “taken together, our results suggest that prizes can be an important inducement for innovation. The contests organized by the RASE attracted large numbers of inventors and the competitions as public events encouraged the diffusion of useful knowledge across innovators,” id. at 6, and that “[i]nsofar as policy changes require supporting empirical evidence, our findings suggest that inducement prizes for innovation can work.” Id. at 25.

Figure 6.1. When might prizes be used as opposed to other philanthropic mechanisms?



Source: McKinsey<sup>48</sup>

As indicated in the above chart, if the predicate conditions (namely, a clear achievable goal with many problem solvers willing to bear risk) are not present, then other instruments, such as grants or contracts, may be appropriate.

The chart would appear to apply best to incentive prizes directed toward a specific, measurable, ex ante target. With other types of prizes, such as recognition prizes, or idea contests, the problem statement and goal are inherently less clear. However, there are literally tens of thousands of recognition prizes and idea contests, and they can be mounted effectively by small institutions with little economic means, and need not aim for large impact.

And further, to extend the McKinsey analysis, we would note that there are several additional factors to be considered and which favor the use of prizes, particularly in the development sphere. Although they are on different analytic levels, the factors include the following:

<sup>48</sup> McKinsey report at 37.

1. Whether an issue is badly *underpublicized*. In such areas – examples might include sanitation, or the plight of foster children – a prize might have even greater impact.
2. Whether there are not merely “many”, as in the McKinsey chart, however that is defined, but rather potentially *huge numbers of entrants*, ranging from hundreds to thousands to millions, with *low barriers to entry*. This is the case with prizes focused on data/algorithms, or on many participation prizes, where the aim is to often to elicit participation from individual citizens. Prizes with mobile phone carrier sponsors may be particularly effective in reaching, tracking, and rewarding large numbers of participants.
3. Whether there is a particularly compelling *visual image* or other very media friendly element. Capturing the public imagination can make for a very powerful prize.
4. Whether the problem and the related prize competition have the potential to *inspire*. This is somewhat related to the above factor, but worth mentioning in its own right. Prizes are not merely about the numbers and the policy. As an instrument, they are fairly unique in their ability to inspire not just competitors but the public at large.
5. Whether the prize competition can operate in tandem with an existing *program* or *movement*. Such a program can enhance the effectiveness of a prize in several ways -- by attracting competitors, by providing a field presence, and by aiding with distribution or achieving impact at scale. One can conceive of a “prize layer” that sits on top of and supercharges an existing effort, helping the program achieve its goals.
6. Whether there is a very discrete and objective and self-contained problem that is indeed a true bottleneck, the resolution of which on its own would be highly likely to solve a problem. While all development problems are complex and have multiple interacting causes, eliminating even one barrier can be a step forward. But occasionally there is a situation where there is a simply critical barrier or deficit that is amenable to a prize. In these situations one can more readily have the desired transformative impact.<sup>49</sup>

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<sup>49</sup> An example here might be the concept of a prize for open source/computational biology-driven drug design for neglected diseases. The barrier there is in significant part a scientific/technical one. Recent drugs for most neglected diseases simply do not exist, as there has been a paucity of effort from the major pharmaceutical companies, given that these are diseases of the poor. If a drug could indeed be developed on an open source, patent-free basis, through a collaborative open source approach akin to Linux, where the effort was further enhanced by a prize, then the ensuing drugs could achieve impact through generics manufacturers and possible Advanced Market Commitments, and achieve widespread distribution through the existing public health infrastructure of clinics, national health programs, and other institutions.

## 7. Designing and Operating Prizes

At the end of an Olympic event, a medal is awarded. Similarly, at the end of an incentive prize competition, the purse is awarded. But the actual award of the purse is only the final step in a series of events.

The first step is the prize design process. Undertaking a thorough prize design process is crucial for success. If one has targeted the wrong problem, identified the wrong area of opportunity, set the bar in the wrong place, framed the issue inappropriately, or constructed a competition that is not feasible to operate, then the prize will suffer, as it is difficult and expensive to change post-launch.

For that reason, the prize design process (as described further in the Appendix) at the X PRIZE Foundation and likely other places is quite lengthy - lasting from 6 to 9 months for a single prize. The process is part analytic and part creative.<sup>50</sup> The aspect of creativity cannot be overemphasized. One cannot simply deduce a prize – it is the product of some inspiration. It cannot be read directly from the data or the analysis. The work to develop an effective, imaginative prize is a bit akin to that of an advertising agency, or a group of conceptual artists, albeit closely informed by scientific, policy, and community analysis and concerns. The process encompasses primary and secondary research. It includes a landscape and root cause analysis of the field, an identification of opportunities for breakthrough, interviews and brainstorming with the world's leading experts, the application (in the case of X PRIZE) of the 8-factor prize model criteria (see figure 6.1 below), the formation of an expert advisory panel, all the way through the drafting of master team legal agreements, and detailed business planning for the competitive venues. It should be thorough, as once a prize target is set, it is very difficult to change. As noted in the McKinsey report:

[T]here are no short cuts. Prizes, as a past president of the X PRIZE Foundation told us, exist at the intersection of many fields, including engineering, intellectual property, marketing, public policy, and psychology. Designing them is a complicated task. It is not possible to replicate the success of the Nobel Prizes, the Netflix Prize, or the X PRIZES without investing significant resources in the steps that make those so distinctive: the processes, design features, and strategies that the custodians of those prizes continue to refine. Some of the best prizes invest more than a year in initial prize development, and more time in later evaluation and refinement.

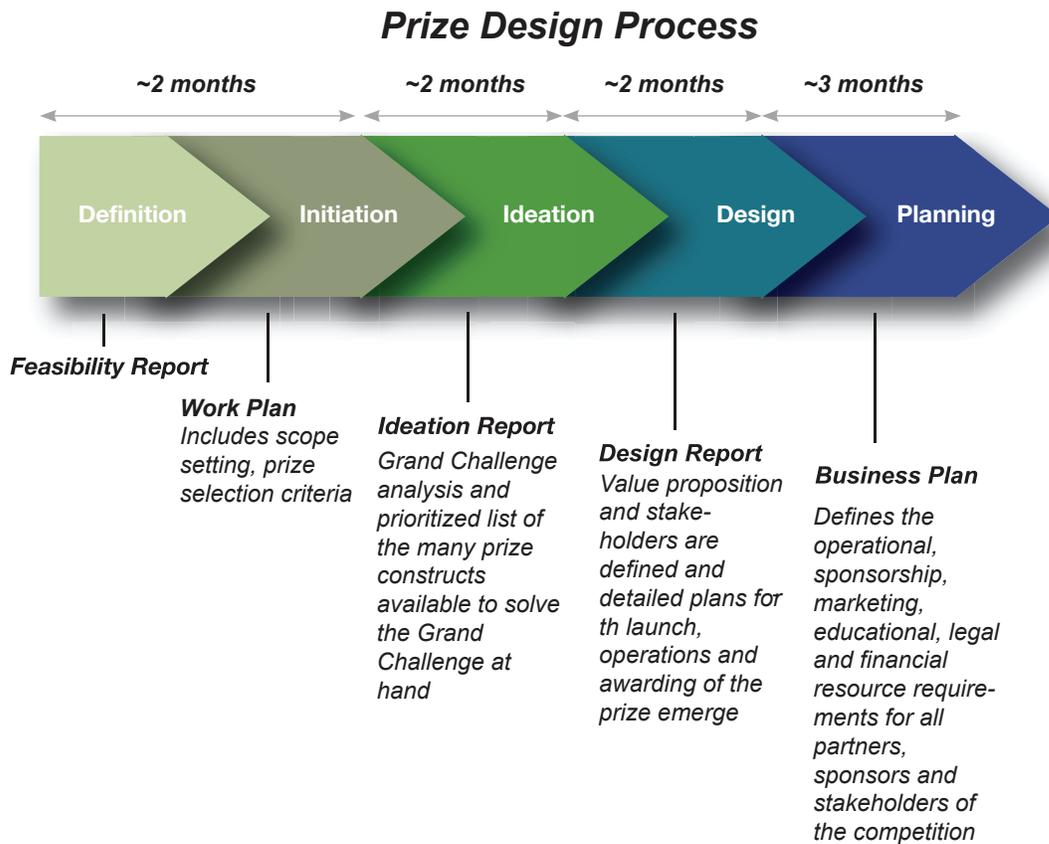
As prize competitions last from one to several years, depending on the structure chosen, and the difficulty of the goal, each prize is akin to launching a company, or a small, bespoke Olympics in a new field.

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<sup>50</sup> “Thou must harbor chaos in order to give birth to a dancing star,” Friedrich Nietzsche, Thus Spake Zarathustra.

Below is a sample timeline of activities for the X PRIZE Foundation prize development process – the activities and durations can vary by project.

**Figure 7.1 Sample Prize Design Timeline**



We also present prize design principles that are used at the X PRIZE Foundation (see below), which offers two types of prizes – the X PRIZE and the X CHALLENGE. X PRIZES are typically 4 to 7 years in duration, with purses of \$10M and up, and seek to effect a paradigm change. X CHALLENGES are typically 1 to 2 years in duration, with purses of \$1-\$2M, and often seek to solve a narrower technical problem.

**Figure 7.2 X PRIZE Foundation Design Principles**

**MARKET ELEMENTS**

ATTRIBUTE	X PRIZE	X CHALLENGE
Help Solve A Grand Challenge	Addresses a problem that significantly impacts the welfare or future progress of humanity. It should give birth to a new capability or industry, or rejuvenate or reform an existing industry, in a way that has long-lasting benefit and impact to humanity.	Gives birth to a new solution or apply a current solution in a new way.
Addresses Market Failure	X PRIZES break an existing constraint erected either by previous obsolete investments (current problem), or lack of structure from underdeveloped markets (future problem). X PRIZES reconfigure what is possible by transcending path-dependent limitations such as societal constraints, legal/regulatory hurdles and policy regimes.	X CHALLENGES promote technological development or behavioral modification, but do not transcend path-dependent limitations such as societal constraints, legal/regulatory hurdles and policy regimes.
Transformative	X PRIZES change the paradigms of a system by redefining incentives and measurements. X PRIZES attract and motivate non-traditional players to attack a problem as well as the world's best and brightest minds to work harder, faster or in entirely new ways.	Not applicable

**PRIZE MODEL ELEMENTS**

ATTRIBUTE	X PRIZE	X CHALLENGE
Measureable, Clear Rules	There must be no question on how a team wins. When creating an X PRIZE or X CHALLENGE, we strive to create simple, clear and objective rules that can be easily understood when shared from one person to another. The rules should define a problem to be solved, not a specific solution to be implemented.	
Competition Type	<p>An X PRIZE can be structured in multiple ways, for example:</p> <ul style="list-style-type: none"> <li>• Date Certain: All teams must compete on a certain day or time-window;</li> <li>• Past the Post: First team to meet/beat a specific metric, can be backed by a specific deadline; and</li> <li>• First to Achieve: First team to solve the challenge wins.</li> </ul>	<p>An X CHALLENGE is usually structured using one of two competition types:</p> <ul style="list-style-type: none"> <li>• Date Certain: All teams must compete on a certain day or time-window; and</li> <li>• Date Certain/Recurring: If the prize is not won the first year, it can be repeated.</li> </ul>
Achievable vs. Audacious	We dial the “degree of difficulty” of the various prize parameters in order to target having the X PRIZE won in a 3 to 8 year time period. This is to ensure that the solution will not be so difficult that interest will be lost, nor be so easy that it is inevitable.	An X CHALLENGE should be structured so that it is won in a 1 to 2 year time period.

## OPERATIONAL ELEMENTS

ATTRIBUTE	X PRIZE	X CHALLENGE
Marketable	Publicity around the prize should educate the public and focus them on the importance of the problem and what the Foundation, its partners and competing teams are doing to solve it. This publicity builds and sustains interest, motivates teams to work harder, and provides increased leverage on the prize purse.	
Telegenic	The prize should be designed to generate popular interest throughout the prize lifecycle, from initial competitor enrollment, to the start of the competition, to the many TV-friendly attempts at winning the purse (both successful and unsuccessful) and following the completion of a competition.	
Leverage	An X PRIZE generates external investment from competitors at an order of magnitude greater than the purse size. Innovators and investors consistently overestimate their likelihood of succeeding, providing fertile ground for experimentation and innovation.	Where possible, X CHALLENGES will be aligned to complement current and future X PRIZES, for example as pre-cursors and early demonstrations of X PRIZE elements.
Operable	The prize must be adequately supported with financial and human resources to effectively execute. Critical partnerships may need to be assembled to ensure this.	
Fundable	The prize has funding secured or has a clear path to the identification and support of a sponsor.	

### **8. The Need for Large-Scale Results: While incentive prizes can be successfully proffered at any point of the innovation chain, the need and the opportunity at the end of the chain is greatest.**

In considering the landscape of prizes today, it might be helpful to start with the notion of the innovation chain, following the approach of IIT Delhi’s Ambuj Sagar (figure 1.1), and of the Everett report and presentation at the workshop in New York. At the beginning of the innovation chain lie concepts and ideas; at the end resides large-scale adoption/impact. Prizes, for their part, can focus on any part of the innovation chain. There are literally tens of thousands of prize competitions at the beginning of the innovation chain, including business plan competitions and idea submission contests. Similarly, a bit further down the chain, there are hundreds of incentive prizes in which the competitors must solve a relatively small challenge. Examples include the US government’s [www.challenge.gov](http://www.challenge.gov), awarding hundreds of prizes, typically of \$2,000 or less for solutions to discrete problems, and USAID’s current Grand Challenges program ([www.usaid.gov/grandchallenges](http://www.usaid.gov/grandchallenges)) (although USAID might pursue larger prizes in the future). They also include private sector companies such as InnoCentive, which allows corporations to post thousands

of challenges online, typically for small cash purses, for the development of solutions particular to that corporation's business needs, NineSigma, and OmniCompete. However, there is a relative dearth of prize competitions at the end of the innovation chain -- to wit, large-scale incentive prizes<sup>51</sup> -- whose aim is to incentivize significant real world results.<sup>52</sup> While small prizes can be mounted by the InnoCentives and other players of this world, a large development institution entering the space could make a more strategic contribution by pursuing large-scale prizes.

The preference for significant results-based prizes was strongly and widely expressed amongst participants in the New York workshop. Elaborating further, Dan Kammen suggested that prizes should be bold and ambitious – the initial Ansari X PRIZE for space flight he noted was thought by many to be unattainable.<sup>53</sup> He recommended looking at the goals we have concerning climate change and development, and crafting prizes that would help us attain those goals, rather than emphasizing what was “doable” as a prize.

Dovetailing with this view is the fact that in development the most pressing need is also for real world, substantial results. There are a plethora of ideas and concepts, and huge numbers of pilot projects, but as noted in the workshops, the most needed outcome is for large-scale or transformative impact.

Lastly, it should be noted that as of now no large-scale development prize platform -- to wit, a grouping with the capability of designing, launching, and operating a series of large scale, results-based incentive prizes to address development challenges, as described further in section 13 -- exists, and that to create one would not be duplicative.

## **9. Not Just For Billionaires: Prizes have worked in the development space by providing incentives to a variety of actors to elicit a range of innovation (technology, business, or social), and by clever pairings with other programs and means.**

Let us address here an opposing point of view. At first blush, the incentive prize model might seem to have little relevance to questions of development. Some obvious threshold questions arise: How does an approach whose renaissance lay in billionaire-funded teams competing fly rockets into space have any

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<sup>51</sup> Everett's Social Challenges and McKinsey's Participation prizes can still be at the end of the innovation chain because the outcome of the prize is a large-scale real world result, rather than an idea.

<sup>52</sup> This not to say that large-scale prizes are unproven. As noted above, there are large and increasing numbers of large scale incentive prizes, backed by national governments and other powerful players around the world, including a substantial number squarely in the fields of energy/environment and development, that further have achieved significant and cost-effective results, as detailed in the Everett report, the KEI report, the McKinsey report, and elsewhere. The implication rather is that while large-scale incentive prizes are proven, there still remains a great need and opening for new ones.

<sup>53</sup> Isaac Newton reportedly considered the goal of the Longitude Prize, won by a self-educated clock maker, to be unattainable. ([www.nmm.ac.uk/harrison](http://www.nmm.ac.uk/harrison))

relevance to questions of poverty and deprivation? If groups are required to provide their own funding, are incentive prizes in the development area workable? And might such a competition be damaging or wasteful, or simply replicate the inequalities and injustices that we are striving to reduce?

The answer in brief is that innovation prizes can and do work in the development arena because prize competitions can provide needed incentives in areas of market and system failure (as discussed in sections 1 and 2); because they focus attention on a problem (as discussed in section 4); and because they reward results, rather than mere ideas or activity, and are thus more directly geared toward having real impact and providing value for money (also as discussed in section 4). Additionally, as will be discussed below, prizes can provide incentives in relation to a broad range of key actors and targets, including in resource-poor environments, with an array of customized structures and also in tandem with other programs, thus making them a useful tool in meeting development challenges.

First, prizes stimulate decentralization and decentralization is good for innovation, especially in the development field. Innovations, by their nature, often come from unforeseen sources and perspectives. More decentralized systems are better able to draw from a wider pool of ideas and potential innovators.<sup>54</sup> Prizes can thus provide incentives to a broad swath of actors, all whom can potentially impact and influence development.

Second, depending on the prize design, incentive prizes can target a wide variety of parties, ranging from the very powerful to the resource poor. The “participation” prize, for example, aims to involve the maximum number of parties and have as an end result an improvement in each or many of them, seeking a shifted bell curve, rather than an outlier performance. The classic example here is of FIRST, a robotics competition for high school students.<sup>55</sup> And in addition to participation prizes, prizes can provide incentives to a broad range of parties, as indicated in the table below:

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<sup>54</sup> Jonathan H. Adler, “Eyes on a climate prize: Rewarding energy innovation to achieve climate stabilization,” *Harvard Environmental Law Review*, Volume 35, March 2011.

<sup>55</sup> FIRST was founded by inventor (and X PRIZE board member) Dean Kamen. Its mission is to “to inspire young people to be science and technology leaders, by engaging them in exciting mentor-based programs that build science, engineering and technology skills, that inspire innovation, and that foster well-rounded life capabilities including self-confidence, communication, and leadership.” See <http://www.usfirst.org/>

**Figure 9.1: Prizes can provide incentives to a variety of parties**

Competitor	Prize or Prize Concept
Technology entrepreneur	Ansari X PRIZE, solar lighting, village-level renewables,
Heads of state	Mo Ibrahim prize
Corporations	Energy-efficient products (e.g., fans), fair trade (e.g. sourcing from certified fair trade producers meeting labor, pricing, and environmental criteria) <sup>56</sup> , cleaner processes (e.g. less water use)
Communities	Shoreline cleanup; total sanitation
Data-miners/algorithm developers	Goldcorp prize, Netflix prize, computational biology/open source for neglected disease
Governments	Nirmal Gram Puraskar (village panchayats in India), “Olympic-style” prizes for MDG/indicator achievement, where teams are consortia of NGOs, government, and private sector
Citizens	Energy use reduction competitions, education prizes
Researchers	Variety

Third, prizes in the development sphere can encompass not only technology innovation but also business, and social innovation, as was the strong consensus in the New York workshop. In each of these areas, prizes could take a number of forms:

- Technology Innovation
  - Technology Creation (e.g., tuberculosis diagnostics)
  - Technology Creation plus Distribution (e.g., cookstoves)
- Business Innovation
  - Scale-up/Distribution (e.g., prize for distributing double fortified salt)
  - Extension of Business Models (e.g., prize for microfinance for agriculture, or crop insurance)
  - Cleaner Business Processes (e.g., prize to reduce water/energy use, or to meet fair trade metrics)
  - Local Fabrication (e.g., prize for village-assembled solar charging kits)
  - New Business Models (e.g., prize for low-cost international money transfer<sup>57</sup>)

<sup>56</sup> Prize concepts for fair trade and “happy supply chains” are being investigated this semester in the X PRIZE Labs course at McGill University Institute for the Study of International Development.

<sup>57</sup> Systems such as Kenya’s M-Pesa work only domestically – the options for international transfer remain expensive and limited. According to World Bank figures, as cited in the Economist Online, international “remittances are expected to total \$483 billion in 2011 and forecast to grow to \$593 billion by 2014. In the third quarter of 2011, sending \$200 abroad, including fees and exchange-rate margins, cost \$18.60 on average [or nearly 10% of the transaction], which is an increase of almost 5% on a year earlier. India and China are the largest remittance-receiving countries. They are expected to receive \$58 billion and \$57 billion respectively this year.” See “Focus: Remittances,” December 11, 2011, Economist Online, <http://www.economist.com/blogs/graphicdetail/2011/12/focus/print>. The opportunity here for a successful new business model, perhaps leveraging new technologies, is astounding – a modest reduction in fees would put billions directly in the pockets of the poor.

- Social Innovation
  - Behavior Change (e.g., obesity reduction prizes for citizens, Mo Ibrahim prize for heads of state)
  - Participation (e.g., FIRST robotics competitions for students)
  - Education prizes (e.g., for agricultural extension)
  - Olympic-style prizes for MDG or other indicator achievement at village, district, city, state/province, or national levels (e.g., Nirmal Gram Puraskar, UNICEF Seal of Approval, or possible global MDG incentive prize).

Fourth, prizes in the development sphere can both complement the important work that is already being done and can be complemented by new additional support from outside the competition. These modalities could include:

- Advance market commitments for the purchase of resulting technologies or services
- Investor eco-systems to assist teams with raising money and receiving mentorship
- Educational programming to inform governments, citizens, and students
- Student entrants to promote youth involvement, and/or
- Integration of the prize into larger efforts (e.g., cookstoves prize with Indian government's National Biomass Cookstoves Initiative, or an MDG prize with the MDG movements).

Fifth, the prize model itself may be adapted to deal with development realities. Modifications or special features include:

- Grant-prize hybrids
- Shared purse for all beyond a threshold, rather than a single winner, to encourage many strivers
- One-third reduction metric to account for varying starting positions and proximities to the benchmark
- Trusts - for Olympic-style, participation, and other prizes; purse can be placed into a trust formed in the winning region and dedicated to the subject at hand
- Criterion of deployment, adoption, or impact at scale in order to win the prize
- Phased prizes, with an initial purse for lab or small scale performance, and a subsequent purse for field performance at scale
- Distributed microprizes, where a purse is split into many tiny pieces, to provide incentives and awards to thousands of winners
- Requirements of affordability for the products generated
- Requirements that the solutions be fabricated locally

In summary, the achievement of transformative results through the innovation prize model depends in some part on the effectiveness of delivery models and institutions, the participation of key players, as well

as on the design of the innovation itself and how well it meets the needs of the users and fits into cultural contexts. The very design of the prize itself can be shaped to embed dimensions that go beyond “hardware,” for example, by requiring uptake or impact at a certain scale in order to be named a winner. Prizes can become integral parts of national government or multilateral programs on the ground. A prize, if constructed correctly, can supply a powerful incentive for a range of actors, from villagers to heads of state to large corporations to nations. Thus successful innovation requires both the generation of new ideas and efforts and impact at scale.

## **10. The Delhi Workshop: Sample Prize Concepts**

We provide here illustrative examples of notions for prizes. Though first, a caveat. The below are but preliminary concepts, the fruit of early brainstorming. Designing a prize is an involved process, often lasting 6 to 9 months for a single prize, as described earlier in this document. What were produced were merely early stage concepts that might (or might not) merit further exploration.

With those cautionary notes in mind, we organized and conducted a “Visioneering” workshop in Delhi with a group of leaders and creative thinkers from the private, NGO, and government sectors, many of whom had both PhDs and extensive field experience.

**Table 10.1: Participants in Visioneering Workshop at IIT-Delhi**

NAME	TITLE	ORGANIZATION
Dr. Ajay Mathur	Director General  Member	Government of India's Bureau of Energy Efficiency  Prime Minister's Council on Climate Change
Dr. Nisha Agrawal	CEO	Oxfam India
Sunita Narain	Director General	Centre for Science and the Environment
Dr. G. V. Ramanjaneyulu	Executive Director	Centre for Sustainable Agriculture, Secundarabad, Andhra Pradesh
Dr. Veena Joshi	Senior Advisor-Energy, Climate Change and Development Division	Swiss Development Cooperation (Delhi)
Dr. Anil K. Ravanshi	Founder and Director	Nimbkar Agricultural Research Institute, Phaltan, Maharashtra
Subjrajit Dey	Manager, Turbomachinery Aerodynamics Lab	General Electric (Bangalore)
Walter Gray, III	Biomass Power Plant Developer/ Investor	
Meenakshi Rohatgi	Correspondent	Technology Review India
Shan Mitra	Team Leader, Climate Change and Development	DFID India
Ankur Chaudhary	Researcher	IIT-Delhi
Ambuj Sagar	Professor	IIT-Delhi
Jaykumar Menon	Senior Director, Education and Global Development	X PRIZE Foundation

A number of ideas emerged from the session and some from subsequent discussions. The ideas were then developed into the concepts presented here.

The prize concepts roughly fell into three categories: technology innovation, business innovation, and social innovation. Participants discussed areas such as biofuels without a food tradeoff, distributed sanitation, scaled village-level renewable energy systems, low cost energy metering, friendly international MDG competitions, smallholder low water agriculture, village-assembled solar charger kits, highly energy efficient consumer appliances, and low carbon building materials. A two foot by three foot poster of each concept was created; smaller copies of the posters are appended as an exhibit. Each poster had the following sections: prize name, purse amount, one line description, grand challenge, competitive guidelines, market failure addressed, follow-on impact, media appeal/telegenic finish, background information.

One might observe that some people are already working on some of these general topics. When dealing with colossal fields affecting billions of people, this is to be expected. The crucial point, however, is that the problems have not been solved. Furthermore, innovation activities in these sectors, even if existent, due to market and system failures are not nearly commensurate with the scale of the problem. Thus the offering of a prize, which often entails the setting of a higher bar or loftier performance standards, coupled with a global spotlight and a powerful incentive, can be of use. And in any event, while the below prize concepts may avowedly not stand up to scrutiny, as the prize design process has not been properly commenced, let alone completed, they are helpful to visualize what the future might bring.

A list of the concepts is presented below. The feeling in the room at Delhi was that if we were able to bring even one of those transformations to fruition, we would have had a significant impact on the world.

**Figure 10.2: Titles of Selected Prize Concepts**

<b>TECHNOLOGY INNOVATION</b>	<b>BUSINESS INNOVATION</b>	<b>SOCIAL INNOVATION</b>
Ultra-Efficient Fan	Low Water Paddy Cultivation	River Resuscitation
Better Building Materials	Village Level Renewable Power	MDG Achievement Prize
Low-Energy Desalination	Open Burn Waste to Energy	
Weed Removal Robot	Cleaner Business Processes	
Reinventing the Flush Toilet		

A description of each of the above eleven concepts is contained in the exhibits to this report.<sup>58</sup>

## **11. The Los Angeles Workshop: Innovators from outside the energy/environment/development fields are interested in prizes there as well**

As promised, we conducted two workshops during the course of this project, one in India and one in New York. The focus of the workshop in India (Delhi) was to generate preliminary ideas for possible prizes and to garner perspectives from the field. The principal aim of the workshop in New York was to probe stakeholder interest.

In addition, however, we conducted four three-hour workshops in Los Angeles, attended by 20-30 people each, on the following topics: renewable energy and storage, hunger/poverty, environment, and water. The workshops were a part of the annual X PRIZE foundation-wide Visioneering meeting, attended by the organization's Board of Trustees, Vision Circle donors, and other key affiliates.<sup>59</sup> Participants learned about the incentive prize model, participated in brainstorming exercises in which they created ideas for prizes, and then voted on the top prize ideas.

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<sup>58</sup> Additional ideas, arising outside of the workshops, for which prize concepts have not yet been developed include:

- Lighting Africa – a prize competition for creating and deploying affordable off-grid lighting solutions, in possible partnership with the World Bank's Lighting Africa program.
- Solar Charger Kits – for developing and distributing kits to villages to local entrepreneurs for assembly into solar-powered chargers. The devices would charge mobile phones or provide light using solar power. The distribution model is based on the Ruf and Tuf Jeans example cited by C.K. Prahalad.
- Nirmal Gram Puraskar Phase Two, an “add-on” to the existing Nirmal Gram Puraskar prize in India, which has already been awarded to 25,000 villages. A second phase of the prize could be added, leveraging the installed base of villages. Discussions have been held with Soma Ghosh Malik of the World Bank, one of the originators of the NGP.
- An African Utilities X PRIZE, in which water or other utilities in Africa (or elsewhere) compete to achieve certain levels of performance, such as 24/7 water or electricity availability. Discussions have been held with the World Bank.
- An Energy Metering X Challenge, for the creation and deployment of affordable and user-friendly village-based energy metering systems, and/or an energy-efficiency participation prize.
- An Energy Efficiency Participation prize, with potentially thousands or millions of participants. Households or businesses that cut their utility bills by a given amount as compared to the previous year would win a share of the purse.
- A Reforestation X CHALLENGE, for the most hectares of trees planted, or forest re-created, meeting certain specifications and constraints, such as limits on or disqualification for displacing people. This would be in possible partnership with the Greenbelt Movement --founded by the recently-passed Wangari Maathai of Kenya, winner of the Nobel Peace Prize -- representatives of which attended the New York workshop.
- A Green Livelihood X PRIZE, in which groups compete to capture the most greenhouse gases, with the proviso that the projects must be of the labor intensive variety, as most carbon-credit projects currently generate little in the way of employment.
- A Mobile Phone Microprize, in which a mobile phone carrier would provide, as a prize, free mobile minutes to end users-participants who had accomplished a designated feat. A possible partnership with Vodacom South Africa, via its Chairman.

<sup>59</sup> Attendees of the two day Foundation-wide meeting included Ratan Tata, Chair of the Tata Group, Eric Schmidt, Chairman of Google, and James Cameron, director of the films Avatar and Titanic. See “James Cameron and Eric Schmidt on Why They “Visioneer” for X PRIZE,” Fast Company, April 20, 2011 <http://www.fastcompany.com/1748569/eric-schmidt-and-james-cameron-tell-us-why-they-visioneer> (visited Jan 8, 2012)

Notably, of the hundreds of ideas created foundation-wide, in fields ranging from space travel to brain-computer interfaces, two of the top three vote getters fell within the ambit of the X PRIZE-DFID collaboration. One was for “Super Brita”, a better and more affordable household water drinking filter, advocated by Rocco Papalia, Senior Vice President of Advanced Research at Pepsi, and another was for a village-scale device that could convert organic (agricultural, food, and other) into clean energy and drinkable water, advocated by Jeff Skoll, founder of the Skoll Foundation and of Participant Media (“An Inconvenient Truth,” “Syriana”), and formerly the first employee at eBay.

While these ideas may or may not have merit, one of the lessons to be gleaned from the exercise is that prizes in energy/environment/development are of interest to major private sector players and innovators from a variety of fields. This was evinced by the popularity of the energy and climate and water prize concepts.

## **12. The Larger Innovation Process: Prizes for development should be seen as a part of larger innovation process and all elements of the innovation process need attention in order to succeed.**

It is increasingly clear that prizes can effectively induce innovative solutions to meet developmental challenges and therefore help address the market failure of the absence of adequate financial and technical resources being channeled into the generation of new ideas or technologies for these particular needs. As noted earlier, this itself has two elements: careful assessment of needs (“needs definition”) and the translation of the need into a “prize specification.”

However, real-world impact requires not just the generation of new ideas or technologies but also creation of impact at scale. This requires the translation of the prize into a product that can be widely available or deployable, and that is actually successfully deployed, or alternatively into a business model or social effort that achieves far reaching results.

Therefore, while the prize model can play an important role, in order to deliver real-world value, one must pay attention to other elements and appropriately link the prize model to a broader process, which can require overcoming technology translation and other deployment barriers – lack of coordination, lack of information and trust, weak institutions, limited availability of finance, absence of support networks, etc. – as mentioned in Section 1.

Notably, different technologies have different innovation needs. For example, the technical needs for advancing more efficient cookstoves are very different from what may be needed to promote solar lighting.

Accordingly, the technical research organizations, the product firms and the ecosystems of organizations that these firms link to will need to be very different. Similarly, the financial requirements for developing these products and bringing them to market are very different. The deployment barriers may be very diverse. In the case of cookstoves, it may be persuading women that new cookstoves can offer them the same cooking service as their traditional stoves, while in the case of solar lighting, the financial needs and the lack of networks may impede innovation. The policies that are needed to advance innovation, especially creating and sustaining markets, may be very different. And actors involved in the field deployment may be very different. In the areas of social and business innovation, having a strong grass roots presence or field reach is critical, and linking the prize process to broader elements such as village structures, international campaigns, national infrastructures, or established distribution channels is vital.

Equally important is the point that promoting the same technology in different countries may have different requirements, depending on the local context (such as technical capabilities, market conditions, and policies). The same point will hold for social and business innovations – these very much have to be tailored for the local, social, economic, and cultural context. Such tailoring cannot be performed here – it will be the work of the individual prize design projects, where issues such as location, partners, and possibly distribution channels, will be analyzed and selected.

Thus there is no simple, cookie-cutter, formula for successful innovation that would work across all cases in all countries. Organizing an effective innovation process requires a bespoke approach based on an understanding of the local innovation gaps, barriers, and institutional requirements. It requires an understanding that the elements of the innovation process -- from need specification to idea generation to translation to deployment and diffusion at scale -- need to be shepherded (especially for such applications where there are no functioning markets to speak of) and coordinated; that a range of policies and institutions play a role in this process; that multiple actors in diverse arenas – individuals, established firms, entrepreneurs, venture capitalists, bankers, foundations, universities, policy-makers, non-governmental organizations, grassroots workers, inter-governmental organizations, and development agencies – and networks are relevant (and different actors are needed for different elements of the innovation process). At the same time, there is some potential commonality and synergy across various areas – even if the needs and processes are not identical, there still is value to sharing of learning across these areas.

This, of course, presents a somewhat daunting picture but we believe that it also is an accurate representation of the reality of these innovation processes. Such a representation also behooves us to think strategically about all elements of the innovation process and plan activities accordingly.

While prizes can induce innovative solutions to meet developmental challenges, real-world impacts

require deployment of innovation at scale. This requires careful assessment of needs (“needs definition”), its translation into a prize specification, and finally deployment of innovation or achieving impact at scale (which itself can require overcoming other barriers – lack of information, weak institutions, need for a field presence, limited availability of finance, support networks, etc.). Therefore in order to deliver value, one must pay attention to other elements and appropriately link the prize model to a broader process.

### **13. The New York Workshop: The Prize Platform - A series of innovation prizes in development is “an idea whose time has come.”**

Our discussions strongly support the view that a series of innovation prizes in development would be an attractive and effective way to meet developmental challenges, and that prizes, like grants, are a “powerful tool that should be in the basic toolkit of many of today’s philanthropists.”<sup>60</sup> In the Everett report, a broad array of prizes were found to have delivered powerful value for money, although proper planning and operation -- just like in proper grantmaking -- is a factor critical to success. In the New York “Visioneering” workshop, there was wide agreement among the participants that there was a need and space for generating and deploying innovations to meet development challenges, and that a platform offering a series of prizes could play an important role in this area.

As Andrew Steer, the special envoy for climate change at the World Bank, said at the meeting, “At the Bank, we feel that this type of instrument is actually a winner ... this is an idea whose time has come.” More recently, through our follow-up to the New York workshop, the UN Secretary-General, Ban-Ki Moon has expressed his interest in such a platform and has given his assent for the Office of the Secretary General to co-host a meeting of funders to establish a platform for a series of innovation prizes in development. The meeting would be conducted by X PRIZE and IIT-Delhi.

To proffer a series of prizes, we would have to take a systematic approach of the kind highlighted above in a series of application areas, coordinating and facilitating the necessary functions and assembling the appropriate teams of stakeholders as needed for each area.

The prize “platform” therefore would have three key activities:

1. needs identification and prioritization;
2. prize design and operation; and
3. generating impact at scale.

The first element is necessary to ensure that the overall process is being directed towards problem areas that are significant (and groups that are most in need) and where the prize approach could make a con-

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<sup>60</sup> McKinsey at 7.

tribution. Here the input of community groups and of citizens/end-users themselves was deemed at the New York and Delhi workshops to be very important. As to the second component, the translation of the need into a prize is itself a process that requires skill. The prize definition must be such that it results in an outcome that can be translated into impact; in some sense, the prize must be both audacious and achievable but in the end, intended to solve a particular problem. Running the prize process also needs careful attention. Outreach is required from the very beginning to ensure maximum participation, and once the prize is launched, auxiliary activities can be designed to enhance the profile of the issue and promote public engagement on it.<sup>61</sup> The third element – deployment and ecosystem, or generating impact at scale – is equally critical: the mere emergence of a new technology, product, or idea is not sufficient to guarantee large-scale uptake – that itself requires overcoming a range of barriers. While this is true even in industrialized countries, it is even more so in developing countries where the markets, actors, and institutions are not as well organized. And achieving scale is critical – there have been many examples of innovations that were successful but only on a small scale, thereby limiting the eventual impact of the innovation. Impact at scale could be achieved in a number of ways: through advanced market commitments, through “bottom of the pyramid” commercial success, through partnerships with organizations with large field presences, through partnerships with national governments, and perhaps by making impact at a specified scale a pre-requisite to winning all or a portion of the prize.

**Figure 13.1**  
**Activities Needed for a Series of Innovation Prizes for Development**

<b>FUNCTION</b>	<b>DESCRIPTION</b>	<b>PARTIES</b>
<b>Needs Identification and Prioritization</b>	Identifying areas of great need and possible breakthrough, using landscape analyses, bottleneck identification, via primary research (interviews) and secondary research	IGOs, NGOs, prize designers, universities, end users and citizens
<b>Prize Design and Operation</b>	Fashioning and operating prizes that achieve desired end-targets, attract the relevant problem solvers, capture the public imagination, utilize manageable competitions, and have clear winners	Prize designers and operators, event production companies, public relations firms, entertainment industry partners, prize competitors, on-the-ground partners (e.g. private sector, governments), technical and measurement agencies
<b>Deployment and Eco-System</b>	Assisting with field presence, distribution of resulting innovations via advance market commitments and other means, education of general public, provision of opportunities for many competitors	Governments, implementing agencies (e.g. Oxfam), private sector, school systems (e.g. further competitions, curricular kits)

<sup>61</sup> Associated activities can include educational programs, awareness-raising events, and overall profile-building to create and sustain broader interest in this area. For example, the Progressive Insurance Automotive X PRIZE (PIAXP) involves a set of competitions, programs and events, including an educational program, funded by a \$3.5 million grant from the United States Department of Energy, to engage students and the public in learning about advanced vehicle technologies, energy efficiency, climate change, alternative fuels, and the science, technology, engineering, and math behind efficient vehicle development.

Such a platform offers multiple benefits:

1. Bringing together in a systematic way, based on an understanding of innovation requirements for specific application areas, relevant stakeholders with expertise in needs analysis, prize design, field presence/deployment, etc.
2. Learning by doing not only by the operators of the platform, but also for many of the key stakeholders that might be involved in multiple prizes
3. Leveraging economies of scale as well as synergies among multiple prize processes
4. Encouraging new types of collaboration among the diverse stakeholders

At the New York workshop, there also was emphatic support for the notion of “innovation” as being not just technology innovation, but, critically, social and business model innovations. There was significant support from almost all participants that the innovation-prize approach should encompass such a broad definition. While prize incentives have frequently been directed at technologists and used to spur technological change, they can and have been used for social change. Efforts such as prizes supplying incentives to villages (e.g. the Nirmal Gram Puraskar prize for sanitation in India), the Mo Ibrahim prize for African heads of state, or the participation prizes concerning energy use (e.g., the Big Green Challenge), show the widespread use of the model in social spheres. Other contemplated social prize examples include a possible project for prize and hunger between X PRIZE and the Gates Foundation, for breastfeeding promotion and an Olympic-style competition for reducing national levels of childhood stunting. In the business world, natural rivalries between companies in the same field can be harnessed. Companies already compete for recognition from third parties in areas such as quality (e.g. the JD Power awards) or customer service. Setting measurable targets in key areas for sustainable development, such as for “happy supply chains”, along parameters such as reduced materials use (water or plastics), or beneficial labor conditions (e.g. paying field workers one cent more per pound of tomatoes<sup>62</sup>), and offering highly dramatic prize competitions, can incentivize industry in salubrious ways. Companies would then be competing amongst themselves to meet objective, measureable, sustainability goals. One also might focus on prizes that operate in alliance with people’s movements, citizen’s movements,<sup>63</sup> and international campaigns<sup>64</sup> as a new path-breaking technique to help those efforts rally the larger support needed to achieve their own goals.

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<sup>62</sup> This might be in alliance with labor groups such as the Coalition of Immokalee Workers, [www.ciw-online.org](http://www.ciw-online.org), a community-based worker organization whose members are largely Hispanic, Haitian, and Mayan Indian immigrants working in low-wage jobs in Florida, which advocated for, and won, a penny per pound increase in wages for tomato pickers. This position was supported by downstream buyers McDonald’s and Taco Bell and endorsed by the New York Times “One Penny More Per Pound,” NY Times Editorial Board, December 3, 2010. <http://www.nytimes.com/2010/12/04/opinion/04sat3.html>. Of course here we might search for similar movements or examples based in the developing world, although the boundaries are ever more porous and the questions ever more global.

<sup>63</sup> Citizens’ movements such as those in the Arab Spring could be assisted by a prize. An influential NGO has suggested to the X PRIZE Foundation that a prize be offered for a technology that would enable web and mobile phone users to use their devices anonymously, to evade central government shutdowns of communications technologies and crackdowns on identified users in times of mass protest. And as discussed above, prizes might operate in tandem with social and environmental movements, with a goal of indicator achievement or in relation to competitions amongst corporations to meet sustainability goals.

<sup>64</sup> As noted above, X PRIZE has had interest from top level players in the MDG movements in pinning a prize to national-level MDG achievement.

We can imagine then that this platform would launch prizes that lead to a variety of innovations – technological, social, behavioral, that could also be aimed at very different outcomes: basic needs met and services delivered through deployment of novel technologies, citizen participation in attaining social goals, and social/behavioral change, etc.

Another theme that emerged was the importance of community involvement. The needs of communities, citizens, and end-users should play a role in the prize process in several ways. As mentioned, these include helping or playing a driving role in identifying needs, goals, and the parameters of the prizes. Some prizes themselves might also have community groups as competitors, provided the competition parameters and possible accompanying grant structures were appropriate.

One of questions that arose was whether prizes could be designed to address simultaneously multiple issues (e.g., economic, environment, and social), since multiple dimensions are important in sustainable development.<sup>65</sup> Analysts at UNICEF proposed an approach where rather than a prize having a single target, the goal would be a weighted grouping of several parameters.<sup>66</sup>

While many prizes operate at the global level, the prize approach could be applied at the national level, or at a much more local level. In fact, it was suggested that a diversity of approaches might be of benefit (and may also attract a larger variety of partners).

In fact, given that some of these innovation prizes are intended to catalyze a paradigm shift, it would be useful to think explicitly about addressing issues of power, agency, and mobilization, which all are central to the development process. For example, could we get a prize to address power relations explicitly? Accountability? Transparency for governments? Mobilizing communities? We might also want to think about a process to get communities involved so that we have learning within the base of the pyramid. In fact, one could even imagine crowdsourcing possible ideas for prizes or aspects of the judging to enhance public engagement. As noted at the workshops, a focus on issues of equity, and of communities in need -- which might mean a focus on bottom income quintiles, or climate resilience in vulnerable communities, and of community input and driving of needs identification and prize goal setting -- may be avenues to incorporate these key concerns.

Some of the prizes could be designed for immediate (although relatively-limited) impact while others could have a longer-term perspective for deeper and disruptive change.

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<sup>65</sup> Of course, we may find that sometimes the relationship between these dimensions is synergistic, and sometimes competitive. For example, energy access and food security impact each other and have trade-offs. We can solve some agricultural problems, but if done inaptly, we would be adversely affecting the water situation or the livelihoods of those on the land.

<sup>66</sup> See the Appendix for their interesting analysis, which meritoriously focused on awarding prizes for achieving desired ultimate development outcomes, rather than merely product creation.

During the workshops, the focus of our exploration regarding potential topic areas centered on the environment/energy area, in keeping with the discussions with DFID.

But we also saw much potential and interest in other areas such as health, where technology can be the key deficit, and where strong distribution networks and providers of advanced market commitments exist. [X PRIZE, for example, has been doing work on prizes in health (e.g., tuberculosis diagnostics with the Gates Foundation; breastfeeding promotion, in likely collaboration with the Gates Foundation and UNICEF, open source drug design for neglected disease, in collaboration with the Open Source Drug Design project of the Indian Council for Scientific and Industrial Research, and is open to further partnerships on each.)] Ultimately, one could eventually imagine a development prize platform with themes for energy/environment, health, hunger, and education.

#### **14. Institutional Architecture: Nimble, Independent, Engaged: Principles for an institutional arrangement for a series of innovation prizes**

In the workshop in New York, the institutional architecture of a ‘prize-centered innovation’ for development program was discussed. If one wished to launch and operate a series of incentive prizes in development, what institutional arrangement would be desirable? What sorts of attributes would the arrangement have? The participants proffered and widely agreed on the following principles and attributes:

- a. *Independent.* The effort should reside outside the multilateral and governmental systems. The effort could be placed in an existing organization or in a specially created new organization. However, it needs to bring on board a large number of partners and stakeholders to ensure progress on each of the three elements of the prize process discussed earlier. Standardized interaction guidelines (or a ‘certified’ MoU) may help in this regard, especially for organizations that are bureaucratic. This will help streamline the creation of partnerships and enhance agility. Some learning from the ‘open source’/‘open innovation’ experiences should be useful in this regard.
- b. *Nimble and Entrepreneurial.* The governance and operation should be streamlined, swift, and supple enough to pursue opportunities.
- c. *Board.* There should be a strong board, with membership from at least two categories: entrepreneurial individuals who have built large, possibly billion dollar, enterprises from the ground up, and top-flight social sector leaders. There was a preference for not including current government officials.
- d. *Three functions.* The arrangement should be able to perform the three functions outlined above -- needs identification, prize design and operation, and deployment/field reach.

- e. *Developing country base.* The operational base should be in a developing country. Proximity to the problems will help with the design process, and will also build capacity locally. The effort, however, should have a global reach.
- f. *Country focus.* Including places with both severe developmental challenges and advanced innovation capabilities could be desirable. Key areas of focus might include the Indian subcontinent and Sub-Saharan Africa.

## **15. Stakeholder Views: “I Want In” - A range of stakeholders have expressed strong interest in the program.**

The participants at the New York workshop were overall very enthusiastic about prizes and about remaining involved as such a program moves forward. One suggestion, from Andrew Steer, was that the World Bank as a trustee of the Green Fund could have the Fund explore incentive prize-based mechanisms. He also noted that the World Bank has a request from the G20 regarding climate finance mechanisms and ways to multiply the impact of climate finance, and that prizes are one such way. In a follow-on meeting with Steer in Washington, he suggested that the platform be launched at the Rio + 20 meeting in June 2012. The UN’s Janos Pasztor was interested in exploring possibilities with the Global Panel for Sustainability. As noted above, UN Secretary General Ban-Ki Moon has expressed his interest in such a platform and has given his assent for the Office of the Secretary General to co-host a meeting of funders. David Ferguson, of USAID, after noting that these were early days and it was not completely clear what the final outcome of this exploration would look like, emphatically stated that, “I want in,” a sentiment that was seconded by others.

Below is a list of the expressions of interest from the above and other parties. Parties marked with asterisks participated in the New York or Delhi workshops.

1. UN Secretary General’s High Level Panel on Global Sustainability (via Janos Pasztor, Secretary\*): needs identification/research, convening.
2. World Bank (via Andrew Steer, Special Envoy for Climate Change\*, Dan Kammen\*, Chief Technical Specialist, Renewable Energy and Energy Efficiency, and Oliver Knight\*, Senior Energy Specialist): (needs identification/research, scientific expertise, possible funding through the Green Fund).
3. UNICEF (via Michele Ferenz\*, Senior Advisor, UN and Governmental Affairs, Chris Fabian\*, Co-lead, Innovation Unit, NYHQ, Mickey Chopra, Director of Health): needs identification, scientific expertise, co-sponsorship of prizes, field/logistical assistance)(particularly in relation to water and sanitation).

4. UNICEF-USA (via Rajesh Anandan and Carolyn Weiderman\*): fundraising assistance.
5. Gates Foundation: planning grant previously provided by Peter Small, for TB diagnostics, other specific prize projects being discussed.
6. Rockefeller Foundation (via Michael Myers\*, Senior Policy Officer and Director of Centennial Programming): convening.
7. Oxfam-India (via Dr. Nisha Agrawal\*, CEO) and Oxfam-USA (via Chris Jochnick\*, Director of Private Sector Partnerships): needs identification, deployment/field assistance.
8. Greenbelt Movement (via Stephen Mills\*, Director-USA, and Peter Ndunda, GIS Specialist: needs identification, deployment/field assistance.
9. Indian Government Ministry of New and Renewable Energy: subject matter expertise, deployment assistance.
10. USAID (via David Ferguson\*): funding, needs identification.
11. Indian Government Bureau of Energy Efficiency (via Dr. Ajay Mathur\*, Director General, and member, Prime Minister's Council on Climate Change): possible series prizes for low cost energy efficient products, enhanced by market/purchase incentives developed with BEE.
12. Ratan Tata, Chairman, Tata and Sons, Chairman, Tata Trusts, Board of Trustees, X PRIZE Foundation: funding, convening power, logistical/operational assistance.
13. Foundation established by a co-founder of a prominent Silicon Valley company: funding.
14. Other high net worth individuals – particularly high tech entrepreneurs: funding, mentoring/networking.
15. UN Office of the Secretary General: convening, co-hosting meeting of prospective funders.

Additionally, the stakeholders mentioned that the external environment in the relatively near future provides opportunities for a prize platform. Key relevant international movements include:

- International Year for Sustainable Energy for All – 2012, as declared by the UN Secretary General
- Millennium Development Goals generally, as they articulate goals that are meant to be audacious, achievable, and objectively measureable, which are precisely the qualities of many incentive prizes
- Rio + 20 conference, June 2012

## **EXHIBIT 1**

### **DELHI WORKSHOP AND PRIZE CONCEPT POSTERS**



भारतीय प्रौद्योगिकी संस्थान दिल्ली  
Indian Institute of Technology Delhi



**Agenda**  
**“Visioneering” Workshop on Incentive Prizes,  
Environment, and Development**

March 30, 2011

IIT-Delhi

Main Building, 8<sup>th</sup> floor, IRD Conference Room

10:35 - 10:40	Welcome - Jaykumar Menon, XPF, Ambuj Sagar, IIT Delhi
10:40 - 11:00	Group Introductions
11:00 - 12:00	Introduction to Incentive Prizes – Jaykumar and Ambuj
12:00 -13:00	Participant Input on Key Challenges
13:00 - 14:00	Lunch
14:00 - 14:30	Prioritization/Selection of Grand Challenges
14:30 - 16:00	Brainstorming of Prize Concepts
16:00 - 17:00	Discussion and Evaluation of Concepts
17:00 - 18:00	Tea and Snacks

**“Visioneering” Workshop on Incentive Prizes, Environment, and Development**

March 30, 2011  
IIT-Delhi  
Main Building, 8<sup>th</sup> floor, IRD Conference Room

**Attendees**

Dr. Nisha Agrawal – CEO, Oxfam India (Delhi)

Dr. Ajay Mathur - Director General, Government of India’s Bureau of Energy Efficiency, member of the Prime Minister’s Council on Climate Change (Delhi)

Dr. G. V. Ramanjaneyulu, Executive Director, Centre for Sustainable Agriculture (Secundarabad, Andhra Pradesh)

Sunita Narain - Director General, Centre for Science and the Environment (Delhi)

Dr. Veena Joshi. Senior Advisor-Energy, Climate Change and Development Division, Swiss Agency for Development and Cooperation (Delhi)

Dr. Anil K. Ravanshi, Director, Nimbkar Agricultural Research Institute (Phaltan, Maharashtra)

Subjrajit Dey, General Electric, Manager, Turbomachinery Aerodynamics Lab (Bangalore)

Walter Gray III, biomass power plant developer for a large multinational (Singapore)

Meenakshi Rohatgi, Correspondent, Technology Review India (MIT’s magazine on innovation) (Delhi)

Shan Mitra, Team Leader, Climate Change and Development, DFID India (Delhi)

Ankur Chaudhary, Researcher, IIT Delhi

Professor Ambuj Sagar, IIT Delhi

Jaykumar Menon, X PRIZE Foundation

# Ultra-Efficient Fan



Category: **Technology Innovation**

Level: **X CHALLENGE**

Purse: **\$2M**

***“Create a highly-efficient fan that decreases energy use ten-fold”***

## GRAND CHALLENGE

- Vast regions of the developing world experience high temperatures and heat waves.
- Climate change is likely to bring even higher temperatures.
- There is a large need for efficient cooling systems.
- Air conditioning is effective but high priced and damaging to the environment.
- The fan is a widespread, low technology and low cost cooling device that could be made more efficient.
- The goal of this competition is to create a new generation of energy-efficient, high performing fans that could cool millions to billions of people with minimal energy use while saving them money.

## DRAFT GUIDELINES

- The winner of this challenge is the team that creates the best-cooling fan (using metrics such as flow rate, air velocity, and others) that uses [10] watts or less.
- Two categories: ceiling fans and table/window fans, with maximum size parameters.
- Fans must also meet minimum criteria for reliability and durability, as well as user field tests.
- Government of India’s Bureau of Energy Efficiency is developing standards for ultra-efficient fans in concert with several other nations – these standards could inform the competition rules.

## MARKET FAILURE ADDRESSED

- Lack of resources, technology and attention devoted to optimizing energy usage for fans as opposed to air conditioners.
- Existing cooling systems both produce and avail themselves of externalities.

## FOLLOW ON IMPACT

- The innovation could spillover into other energy-saving appliances or household items in developing countries.
- Bureau of Energy Efficiency of Government of India is interested in partnering – possibly by affixing meters and remote sensors to monitor use, and by providing cash incentives to assist in the sales and manufacture of highly efficient fans.

## MEDIA APPEAL/ “TELEGENIC FINISH”

- Side-by-side comparison of the ultra efficient fan’s energy usage with other high-energy cooling units, such as air conditioners.
- Visuals of fans in competition, blowing smoke or other objects
- At competition, visuals of people being cooled by the fans on a hot day – fans blowing air at their sweating faces, and the consumers giving their instant thumbs up or down.

## RELEVANT BACKGROUND INFORMATION

- 1) “Estimating Appliance and Home Electronic Energy Use”, U.S. Department of Energy, [http://www.energysavers.gov/your\\_home/appliances/index.cfm/mytopic=10040](http://www.energysavers.gov/your_home/appliances/index.cfm/mytopic=10040)
- 2) “Fans and Blowers”, Bureau of Energy Efficiency, Government of India, <http://emt-india.com/BEE-Exam/GuideBooks/3Ch5.pdf>

# Better Bricks



Category: **Technology Innovation**

Level: **X CHALLENGE**

Purse: **\$1M**

***“Create resource-efficient bricks”***

## GRAND CHALLENGE

- Brick production consumes large amounts of energy in the developing world.
- The brick industry is a major contributor to India's GHG emissions. For example, it is the third largest consumer of coal in India, comprising roughly 8% of the total coal consumption.
- Fuel costs account for 30-40% of the production cost of bricks.
- Sand mining for bricks leads to degradation of river beds and low ground water levels.
- Excavation for brick materials is often unregulated and utilizes large amounts of topsoil.

## DRAFT GUIDELINES

- The winning team will create affordable safe, resource efficient bricks.
- The bricks must meet environmental standards (energy use per brick, degradation caused by acquisition of materials, emissions from kilns).
- The bricks must meet construction industry standards (compressive strength, stability, weight, moisture penetration, and other).
- The bricks must meet safety standards (reducing emissions and/or respiratory disorders in workers).

## MARKET FAILURE ADDRESSED

- Brick production causes major externalities in the form of GHG emissions and soil/land use.
- Lack of research and development in the brick space, since environmental damage can be passed off onto other parties.
- Lack of research and investment in brick production generally due to prevalence of small-scale and low-margin players.

## FOLLOW ON IMPACT

- Greatly reduced energy use.
- Significant financial potential with production of resource-efficient, energy-saving bricks.
- Significant health benefits for brick workers.
- Improved knowledge, technology, and capacity for brick kiln entrepreneurs.
- Better bricks could serve as examples or become the new norm.

## MEDIA APPEAL/ "TELEGENIC FINISH"

- Images of new houses and commercial buildings built with the new bricks.
- Images of the prior destructive sand mining that is no longer taking place.
- Visuals of possible competitions of brick smashing and stacking – perhaps with martial arts masters

## RELEVANT BACKGROUND INFORMATION

- 1) “Energy efficiency improvements in the Indian brick industry”. UNDP – India. <http://www.resourceefficientbricks.org/background.php>
- 2) “Indiscriminate sand mining creates water shortage in Kerala”. The Hindu, Business Line. <http://www.thehindubusinessline.com/todays-paper/tp-economy/article1050912.ece?ref=archive>
- 3) “Morbidity Profile of Brick Kiln Workers Around Ahmedabad City, Gujarat. India”. Dr. Rajesh Mehta, Dr. Niraj Pandit, Dr. Reena Parmar. 1 Healthline. <http://iapsmgc.org/oa7.pdf>

# Weed Removal Robot



Category: **Technology Innovation**

Level: **X CHALLENGE**

Purse: **\$1M**

***“Develop a weed-removing system”***

## GRAND CHALLENGE

- Weeds are a costly problem in agriculture.
- Huge benefits for physical removal of weeds over removal with herbicides, both in increased yields, and reduced environmental damage.
- Weed removal needs to be mechanical for “organic” farmers.
- Weed removal success is greatly affected by timing of removal.

## DRAFT GUIDELINES

- The winning team is the group that is able to remove the most amount of weeds in a given furrow or plot in eight hours, without damaging the target crop more than once. Performance must be repeated three times.
- Weed removal may not have a negative effect on various crops and the environment.
- Technology must be affordable and adaptable to manual operation for use in regions without easy energy access.

## MARKET FAILURE ADDRESSED

- Relative lack of attention given to weed removal methods for small farmers, given their limited purchasing power

## FOLLOW ON IMPACT

- Significant improvement in crop productivity.
- Significant financial potential with higher crop production.
- Greatly improved environmental impact on agricultural land with mechanical weed removal.
- Showcasing and testing of innovations created by small farmers themselves.

## MEDIA APPEAL/ “TELEGENIC FINISH”

- Images of weed infestation in agriculture.
- Visuals of weed-removing competition in action. Simple robots might have cameras and scanners, and compare weeds to images in their on-board image database.

## RELEVANT BACKGROUND INFORMATION

- 1) “CABI in review 2010”. CABI, Scientific Research Base.  
<http://www.cabi.org/default.aspx?site=170&page=999>
- 2) “Present trends in weed management”. R. Labrada.  
<http://www.fao.org/docrep/006/y5031e/y5031e0j.htm>
- 3) “Weed Control in Conservation Agriculture”. Andrew Price and Jessica Kelton.  
[http://www.intechopen.com/source/pdfs/13131/InTech-Weed\\_control\\_in\\_conservation\\_agriculture.pdf](http://www.intechopen.com/source/pdfs/13131/InTech-Weed_control_in_conservation_agriculture.pdf)

# Reinventing the Flush Toilet



Category: **Technology Innovation**

Level: **X CHALLENGE**

Purse: **\$2M**

**“Develop a sustainable, closed loop toilet”**

## GRAND CHALLENGE

- 2.5 billion people globally need access to basic sanitation. Of this population, 1.2 billion worldwide have no sanitation at all and are forced to practice open defecation. The areas of highest prevalence are South Asia and sub-Saharan Africa.
- A majority of wastewater treatment systems are centralized and inefficient, using large amounts of water and energy to transport waste many miles through sewers to a waste processing facility.
- Current sewage systems can be considered “pathogen dispersal systems”
- Failures in the sanitation system create significant health risks by contaminating water, food and the environment, thus transmitting diseases. An estimated 2 million people per year die due to diarrheal diseases.
- Many existing toilet improvements have focused on low-water use in the bowl, but not on what happens afterwards.

## DRAFT GUIDELINES

- The winner of this challenge is the team that develops a low-cost, sustainable, closed loop toilet that processes and denatures waste on-site.
- The waste must be processed in a closed, isolated space away from harmful contact with people, but yet in close proximity to the toilet itself. The system must also be leak-proof and unbreakable so as not to harm the environment around it.
- The system must use little to no water or chemicals in the process.
- The feces or urine must be rendered inert or transmuted into a form of valuable use to the environment and society, such as an energy source or soil fertilizer/enhancement.
- The system must be affordable for the poor in developing countries.

## MARKET FAILURE ADDRESSED

- Lack of innovation and investment in revamping the flush toilet model and sanitation system, due to lack of market failure and perceived lack of prestige/excitement.
- The commercialization and affordability of sustainable toilets in developing countries.

## FOLLOW ON IMPACT

- Possible new product that could be scaled across developing world.
- The product created from the waste could spur markets in multiple industries.

## MEDIA APPEAL/ "TELEGENIC FINISH"

- Human interest videos and stories about people and communities benefiting from the toilet.
- Documenting the “flush to product” lifecycle.
- Tap into the fascination with things scatological.
- Simple and powerful – meets criterion of “could a child understand it?”

## RELEVANT BACKGROUND INFORMATION

- 1) “Water, Sanitation and Hygiene Statistics”, UNICEF. [www.unicef.org/wash/index\\_statistics.html](http://www.unicef.org/wash/index_statistics.html)
- 2) “Decentralized Wastewater Treatment Systems: A Program Strategy”, US EPA, [www.epa.gov/owm/septic/pubs/septic\\_program\\_strategy.pdf](http://www.epa.gov/owm/septic/pubs/septic_program_strategy.pdf)
- 3) “The Flush Toilet is Ecologically Mindless,” Sunita Narain, Centre for Science and the Environment. [www.ecosanservices.org/publications.html](http://www.ecosanservices.org/publications.html)

# Low-Energy Desalination



Category: **Technology Innovation**

Level: **X PRIZE**

Purse: **\$10M**

***“Convert salt water into drinking water using little energy”***

## GRAND CHALLENGE

- 97% of the Earth’s water is salt water, and an additional 2% is frozen, leaving less than 1% as accessible fresh water.
- Current desalination systems are extremely energy intensive, emit large amounts of briny waste, and are very expensive.
- A breakthrough in very-low energy desalination would allow us to access the majority of the earth’s water and would transform the world.

## DRAFT GUIDELINES

- The winner of this prize is the team that desalinates 1 million cubic meters of water with least amount of energy (watts) per cubic meter.
- Possible alternate competition requiring energy to be solar.
- Treatment of the waste product (brine) must also be included in the energy budget.

## MARKET FAILURE ADDRESSED

- Open question as to whether there is sufficient investment here across all relevant niches, including those where purchasing power is low. Significant likelihood that a prize may not be necessary given the amount of investment and the possible huge follow-on market. Further research is necessary.

## FOLLOW ON IMPACT

- A true breakthrough would enable enable poor people to tap into the vast majority of the earth’s water for drinking purposes.

## MEDIA APPEAL/ “TELEGENIC FINISH”

- Simple and clear concept - meets criterion of “could a child understand it?”
- Possibly hold the competition on the shores of the Dead Sea, if salinity and operational conditions are appropriate.

## RELEVANT BACKGROUND INFORMATION

- “For Want of a Drink – A Special Report on Water”, The Economist, May, 2010.
- “Thirsty? How ‘bout a cool, refreshing cup of seawater?”. USGS.  
<http://ga.water.usgs.gov/edu/drinkseawater.html>

# Low-Water Paddy Cultivation



Category: **Business Innovation**

Level: **X CHALLENGE**

Purse: **\$1M**

## “Create Low-Water Paddy Fields”

### GRAND CHALLENGE

- Paddy cultivation is highly water intensive, requiring approximately 5000 liters of water to grow one kilogram of rice.
- Paddy fields with artificially controlled hydrological conditions (namely irrigation) comprise about half of the world’s paddy fields, and produce about  $\frac{3}{4}$  of the world’s rice production.

### DRAFT GUIDELINES

- Competitors will be assigned adjacent plots of one acre each and the same limited quantity of water.
- The winning team will be the one that cultivates the most kilograms of rice.
- Rice must meet specific minimum quality standards.
- In order for any team to win, rice must be cultivated with at a maximum of 2500 liters of water per kg of rice – which is roughly a 50% in reduction of water use.
- Techniques must not be capital intensive, meet fertilizer input constraints, and require less than a maximum number of person or animal hours.
- Additional possible purse for implementation of approach on a large scale.

### MARKET FAILURE ADDRESSED

- Relatively low investment given scale of the problem, as small rice cultivators are often impoverished.
- Water for irrigation is often underpriced, used indiscriminately, and diverted from better use.

### FOLLOW ON IMPACT

- Increased income for huge numbers of small rice farmers.
- Decreased agricultural water use for a principal global crop.
- Increased climate resilience in rice farming.

### MEDIA APPEAL/ "TELEGENIC FINISH"

- Images of adjacent paddy fields and competitors working those fields.
- Television interviews with the small farmers who are competing.
- Images of water use in regular paddy field versus competitors’ fields.
- Visuals of piling up the grains into a single mound to see which mound is largest.

### RELEVANT BACKGROUND INFORMATION

- 1) “Crop”. UNCTAD. <http://www.unctad.org/infocomm/anglais/rice/crop.htm>
- 2) Proceedings of the International Workshop on Water Saving Practices in Rice Paddy Cultivation, International Committee on Irrigation and Drainage, 14-15 September 2006 Malaysia, including “Water Saving Practices in Rice Paddy Cultivation,” Yoshisuke Nakano (2006), [http://www.icid.org/paddy\\_japan.pdf](http://www.icid.org/paddy_japan.pdf), and Water Efficient Irrigation and Environmentally Sustainable Irrigated Rice Production in China, Mao Zhi (2006) [http://www.icid.org/wat\\_mao.pdf](http://www.icid.org/wat_mao.pdf)

# Cleaner Business Processes



**Category: Business Innovation    Level: X CHALLENGE    Purse: \$1M**

## “Corporate re-engineering to help the environment”

### GRAND CHALLENGE

- Industrial usage causes a large proportion of global environmental stress and damage, ranging from GHGs to water use to other areas.
- The field of corporate social responsibility is growing in stature, but could be pinned more closely to real world results.

### DRAFT GUIDELINES

- Head-to-head competitors will be corporations of a given minimum size in a selected industry. Industries to be selected biannually, for a rotating competition.
- The winning team will be the ones that reduces its water use, GHG emissions, electricity use, or other selected metric by the greatest percentage, and/or by the greatest absolute numbers.
- Winner must submit utility bills, meter readings, and an audited environmental statement.

### MARKET FAILURE ADDRESSED

- Environmental impact is largely an externality, and is not fully priced into business processes. As a result, incentives to reduce environmental impact are lacking.
- Information markets are also lacking, as claims of corporate environmental responsibility are often incommensurable, and are rarely vetted and verified.

### FOLLOW ON IMPACT

- Virtuous cycle of companies competing for the honor of having diminished environmental impact.
- Cleaner business processes will result, and not merely at an anecdotal or one-off level, but rather in aggregate impact at a company-wide scale.
- More commensurable and more publicized information about corporate environmental impact.
- Increased public awareness.

### MEDIA APPEAL/ "TELEGENIC FINISH"

- Winners will tout their virtuousness.
- Public scorecards of brand name companies and where they finish.

### RELEVANT BACKGROUND INFORMATION

- 1) “Charting Our Water Future,” 2030 Water Resources Group Report, authored by McKinsey and Company, May 2010.

# Village Level Renewable Energy



Category: **Business Innovation** Level: **X CHALLENGE**

Purse: **\$1M**

## “Renewable energy production for a village”

### GRAND CHALLENGE

- Nearly two billion people in the developing world have no access to electricity.
- The alternative to electricity are kerosene lamps for lighting and biomass for cooking, both of which often are the culprits for major health issues.
- Electric lighting will let children study in the evening hours and adults will be able to add additional income generating work.

### DRAFT GUIDELINES

- The winning team will supply village-scale renewable power to at least 1000 villages and at least 100,000 people, providing a to-be-determined minimum number of kilowatt-hours of energy.
- Energy must be 90% from renewable sources.
- System needs to adhere to local environmental regulations and must not, for example, add to deforestation.
- System needs to be in operation for one year and provide consistent power.
- Community is able to operate, maintain, and repair the system on their own.

### MARKET FAILURE ADDRESSED

- Energy access in poor rural areas is lacking due to a number of systemic and market failures.
- Available fuels such as kerosene and diesel are expensive and can be harmful to human health and the environment.

### FOLLOW ON IMPACT

- Education level risen with children being able to study in the evening hours.
- Economic growth due to business opportunities with electricity/power.
- Access to mobile phone service with ability to charge mobile phones, which will lead to economic and safety benefits.

### MEDIA APPEAL/ "TELEGENIC FINISH"

- Children able to study in the evening with electric lights.
- People's ability to add additional income-generating work during evening hours.
- Whole villages working together to build, manage, operate, and repair energy systems.

### RELEVANT BACKGROUND INFORMATION

- 1) “Energy for all”. [www.energyforall.info/](http://www.energyforall.info/)
- 2) “Barefoot Power”. [www.barefootpower.com](http://www.barefootpower.com)
- 3) “Bushlight India: Case Study 5”. Cat Projects. <http://www.catprojects.com.au/fact-sheets/>

# Open Burn Waste to Energy



Category: **Business Innovation**

Level: **X PRIZE**

Purse: **\$5M**

## "Transforming agricultural waste into a commodity"

### GRAND CHALLENGE

- Hundreds of millions of tons of agricultural residue or waste are created every year after harvesting and processing crops.
- The practice of burning this agricultural residue, known as "open burning", is a controversial issue.
  - On one hand, open burning can help farmers get rid of weeds, dead plants and plant diseases as well as increase crop production.
  - However, the practice contributes to air pollution, global warming and climate change and threatens public health and safety, and also may leave a valuable source of energy unused, and a powerful economic engine for farmers untapped.
  - Furthermore, what is being burned now, as opposed to being used for feed or fuel, is likely to be true waste.

### DRAFT GUIDELINES

- The winner is the team that generates an alternative, non-burn use for agricultural waste that produces the greatest economic value with minimal environmental impact.
- The solution would be in line with the 3 F's: fuel, feed or fertilizer.
- The output would be measured in economic terms, using prevalent market prices.
- The financial and economic impacts of the adoption of these alternatives must be minimal. The method must be easily adopted by farmers.
- The solution must pose little to no harm to the public.

### MARKET FAILURE ADDRESSED

- The missed market opportunity in creating economic value from waste.
- Renewable energy appears falsely expensive, due to uninternalized externalities from fossil fuels.

### FOLLOW ON IMPACT

- Reductions in air pollution in areas normally practicing open burning.
- The short-term and long-term economic impact on the farmer and community created by the waste alternative.
- What is being burned comes close to true waste, meaning that any economic value generated from it is a plus.

### MEDIA APPEAL/ "TELEGENIC FINISH"

- Side-by-side comparison of open burning versus waste alternatives. Each competitor would be given the same amount of agricultural waste to work with, however, the outcomes will be different.
- Examples of farmers, the regional economy, or consumers benefiting from solutions.
- Television interviews with farmers to get their reaction and opinions on the solutions.
- "Waste to energy - the new alchemy."

### RELEVANT BACKGROUND INFORMATION

- 1) "Agricultural Burning". US EPA. <http://yosemite.epa.gov/r10/airpage.nsf/webpage/agricultural+burning>
- 2) "Agricultural Residues". California's Department of Resources Recycling and Recovery. <http://www.calrecycle.ca.gov/Organics/Conversion/AgForestRpt/Agriculture/>

# River Resuscitation Prize



Category: **Social Innovation**

Level: **X PRIZE**

Purse: **\$10M**

## “Revive dead rivers”

### GRAND CHALLENGE

- River pollution is endemic. Major rivers such as the Yamuna in Delhi are filled with sewage and other noxious waste to the point that they are effectively dead.
- Pollution stems from sewage, industrial waste, agricultural runoff, and other sources.
- Coordinated action and mobilization is needed to address the issue.
- The goal of this competition is to bring rivers back to life – to a state where they are more beautiful than foul and can properly support and co-exist with human and animal life.

### DRAFT GUIDELINES

- For a given river, baseline pollution levels will be recorded at various points of the river, ideally using existing and reliable measurements.
- The winning team is the one that most reduces the amount of pollution added to the river over the course of its section.
- Awards will be given for the greatest percentage and greatest absolute reductions, or possibly for a blend of the two.
- Teams are cross-sector consortia of government, NGO's and private sector – one team per section of the river.
- Award to be placed into a trust in the winning areas dedicated to environmental issues.

### MARKET FAILURE ADDRESSED

- River pollution is caused by a series of market externalities, as polluters need not pay for the cost of their pollution.
- Effective regulation of rivers is generally a public good, not supplied by the markets.
- River cleanup involves concentrated costs, and yet diffuse benefits.
- Multiple, overlapping agencies exercise jurisdiction – leading to difficulties in concerted action.

### FOLLOW ON IMPACT

- Converting a reeking morass into an even somewhat glittering waterway would be a major human achievement, and could transform the face of a community or city.
- Revitalized rivers provide better livelihoods for those in the fishing industry.
- Positive health and drinking water effects.

### MEDIA APPEAL/ "TELEGENIC FINISH"

- In cities: competition will leverage extensive media attention already given to metropolises and their rank rivers.
- In cities and rural areas: shoreline cleanup days, incentivizing riverside communities to clean up physically accessible waste
- Possible mega matchups: Ganga vs. Amazon (river versus river), or Lagos vs. Delhi (city v. city), or Ganga vs. Ganga (sections of the Ganga versus each other).
- Mayors or other public figures drink water on camera from the river.
- Swimming across the river by public figures at end of competition period.

### RELEVANT BACKGROUND INFORMATION

- 1) “Indian Rivers are Drowning in Pollution”. Fortune Magazine. [http://money.cnn.com/magazines/fortune/fortune\\_archive/2007/06/11/100083453/index.htm](http://money.cnn.com/magazines/fortune/fortune_archive/2007/06/11/100083453/index.htm)

# MDG X PRIZE



Category: **Cross-cutting**

Level: **X PRIZE**

Purse: **\$100M**

## "Accelerate the achievement of a Millennium Development Goal"

### GRAND CHALLENGE

- Millennium Development Goals are designed to be objectively measurable, audacious, and yet achievable – which are exactly the same characteristics of the target of an X PRIZE.
- MDG efforts are strong and ongoing but could use further support.
- Given the amount spent on the MDGs, a small and complementary prize “layer” helping those programs realize their goals would offer significant ROI.
- The goal of this competition is to accelerate the achievement of the MDGs (and post MDG efforts) by providing a global sense of drama, sharper deadlines, encouraging social, business, and technological innovation, focusing on results, and promoting cross-sectoral collaboration.
- In some sense, it would be the biggest prize of all. In another sense, it would be relatively simple, as it is merely an overlay.

### DRAFT GUIDELINES

- Akin to the Olympics, teams are cross-sector consortia of private sector companies, government, and NGOs.
- Performance measured at a national or state/district (>5 million population) level; one team represents each area. Performance along one MDG or a blended metric of all MDGs.
- Purse shared by all nations/areas meeting a threshold; special award to best performer; awards placed in trust dedicated to development in the area.
- Hunger example:
  - Metrics for hunger defined by MDG One, Target Three, specifically:
    - Indicator 1.8: Prevalence of underweight children under-five years of age
    - Indicator 1.9: Proportion of population below minimum level of dietary energy consumption
  - \$10M purse to team with largest percentage reduction in hunger as per the above metrics; remainder of purse to be shared by all regions achieving [50%] reduction of hunger.

### MARKET FAILURE ADDRESSED

- Development is ridden by market and systemic failure.
- It is possible to do something about world poverty and other global problems, if societies set their minds to it (e.g. Brazil’s halving of hunger in less than eight years).

### FOLLOW ON IMPACT

- Even slight improvements in MDG performance affect millions to billions of people.
- Improvements tend to have inter-generational effects and raise GDPs.
- Exemplary effects of winning and successful teams.

### MEDIA APPEAL/ "TELEGENIC FINISH"

- Friendly Olympic-style competition to solve some of the biggest problems in the world.
- Potential involvement of major entertainment figures, e.g. Bob Geldof’s We Are the World, redux, and the International Olympic Committee.
- Press/media events throughout prize cycle.
- Reality shows hosted by prominent actors tracking relative status of competitors (the Great Race) and stories from the field.
- Prizes awarded by UN Secretary General, on the floor of the General Assembly

### RELEVANT BACKGROUND INFORMATION

- 1) “A Gateway to the UN System’s Work on the MDGs” [www.un.org/millenniumgoals/poverty.shtml](http://www.un.org/millenniumgoals/poverty.shtml)

## **EXHIBIT 2**

### **NEW YORK WORKSHOP REPORT**

**A WORKSHOP CONVENED BY THE X PRIZE FOUNDATION  
and INDIAN INSTITUTE OF TECHNOLOGY DELHI\***

**at UNICEF Headquarters  
New York, New York, July 20, 2011**

**WORKSHOP REPORT**

**OBJECTIVE**

This workshop aimed to initiate a high-level dialogue to explore the potential of using innovation prizes to generate solutions to meet pressing environmental and developmental challenges. Accordingly, it brought together a select number of senior decision-makers and experts from bilateral and multilateral development agencies, non-governmental organizations, and foundations for an open discussion on the merits of the innovation prizes, the challenges and opportunities in implementing this approach to address developmental challenges, and the institutional framework that could help advance such an implementation.

**BACKGROUND/RATIONALE**

Despite concerted efforts over the past decades, there still exist a range of enormous environmental and developmental challenges that are vexing for humanity as a whole, but particularly problematic for the world's poor. The WHO estimates that 2.5 billion people suffer from poor sanitation facilities and nearly one billion lack access to clean water. The IEA estimates that 2.5 billion people rely on biomass-based polluting cookstoves for their household energy needs. In fact, such concerns are among the largest current risk factors for the poor: unsafe water, poor sanitation, and indoor air pollution by themselves account for almost three million deaths per year. In addition, we urgently need to begin tackling mitigation and adaptation challenges posed by climate change that will necessitate transitioning to a low-GHG and climate-resilient development paradigm while also making progress on energy access for the poor.

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\*Supported by the United Kingdom Department for International Development

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But there has been a clear market failure on this front. Despite the potential gains, the global knowledge enterprise has not focused on these problems, at least at a level commensurate with their scale. The world's innovation capabilities are mainly located in industrialized countries, and there principally within the private sector, with activities being driven largely by market opportunities and the personal motivations of experts (such as advancing knowledge). To the extent there are efforts aimed at advancing innovation for the world's poor, these often are fragmented, take a piecemeal approach to innovation, and have few synergies with each other.

“Innovation prizes” are increasingly seen as a highly effective way to induce the development of technology in areas that are neglected by traditional market forces. Specifically, this refers to “an ex-ante grand prize” which is designed to catalyze the achievement of a specific result, often by stimulating R&D or technology (or prototype product) development. A recent review of the innovation-prize model indicated both the effectiveness and cost-efficiency of this novel approach. This mechanism may be particularly well-suited to the development arena, given the paucity of relevant organized and well-funded innovation activities, but this is an area that not been explored much so far. This, then, was the motivation for our workshop:<sup>1</sup> to get the perspectives of a range of diverse stakeholders of the applicability and value of an innovation-prize approach in the development arena, to get a feel for the possibility, and the possible modalities, of bringing together key actors to realize the gains from such an approach.

## DISCUSSION

There was wide agreement among the participants that there was a need, and space for, generating and deploying innovations to meet development challenges and that the innovation-prize model could play an important role in this area. As Andrew Steer, the special envoy for climate change at the World Bank, said at the meeting, “At the Bank, we feel that this type of instrument is actually a winner... this is an idea whose time has come.”

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<sup>1</sup> This is the second workshop as part of a project sponsored by DFID, which is interested in exploring the question of how incentive prizes could work in development. The first workshop in Delhi in March 2011 focused on generating prize concepts, drawing on the experiences of experts from grassroots groups and other NGOs, government agencies, bilateral donors, and private firms. These concepts may not merit actual launch or even further exploration but rather reflect an initial brainstorming process - fully designed and executable prizes are the result of an intensive prize design and vetting process that lasts six to nine months, as described in X PRIZE Foundation documents. Additionally, in Los Angeles, during the X PRIZE Foundation's annual foundation-wide Visioning meeting in April 2011, attended by Ratan Tata, Google Chair Eric Schmidt, and others, four separate three hour workshops were held on topics relevant to this DFID project, on the subjects of renewable energy, water, environment, and poverty and hunger, each attended by 20-30 people.

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There also was a fairly rich discussion on the notion of “innovation” as being more than just technology innovation, although that is extraordinarily important, but also including social and business model innovations. There was significant support from almost all participants that the innovation-prize approach should encompass such a broad definition.

It was also noted that the mere development of a new technology, product, or idea is not sufficient to guarantee large-scale uptake – that itself requires overcoming a range of barriers. While this is true even in industrialized countries, it is even more so in developing countries where the markets, actors, and institutions are not as well organized. Thus both the generation of innovation and ensuring impact at scale are equally important. In fact, prizes may be able to play a particularly critical role at the latter end of the innovation chain.

Dovetailing with this view was Bryony Everett’s account of the landscape of prizes. As she noted, there was a need for prizes at the end of the innovation chain. While there are scores of prize competitions at the beginning of the innovation chain (such as business plan competitions), whose purpose is to elicit ideas, there is a dearth of prize competitions at the end of the innovation chain (to wit, large-scale incentive prizes), whose aim is to incentivize significant real world results.

Accordingly, the three key component of a prize process for development would be 1) needs identification and prioritization, 2) prize definition and operation, and 3) generating impact at scale. The first element is necessary to ensure that the overall process is being directed towards problem areas that are significant (and groups that are most in need) and where the prize approach could make a contribution. Here the input of community groups and of citizens/end-users themselves was deemed to be very important. As to the second component, the translation of the need into a prize is itself a process that requires skill – the prize definition must be such that it results in an outcome that can be translated into impact; in some sense, the prize must be both audacious and achievable but in the end, intended to solve a particular problem. Dan Kammen here suggested that prizes should be bold – the initial Ansari X PRIZE for space flight he noted was thought by many to be unattainable. He is looking at the goals we have concerning climate change and development, and crafting prizes that would help us attain those goals, rather than emphasizing what was “doable” as a prize. Running the prize process also needs careful attention – outreach is required from the very beginning to ensure maximum participation, and once the prize is launched,



auxiliary activities can be designed to enhance the profile of the issue and promote public engagement on it.<sup>2</sup> The third element – deployment or impact at scale – is equally critical: the mere emergence of a new technology, product, or idea is not sufficient to guarantee large-scale uptake – that itself requires overcoming a range of barriers. While this is true even in industrialized countries, it is even more so in developing countries where the markets, actors, and institutions are not as well organized. And achieving scale is critical – there have been many examples of innovations that were successful but only on a small scale, thereby limiting the eventual impact of the innovation. Impact at scale could be achieved in a number of ways: through advanced market commitments, through “bottom of the pyramid” commercial success, through partnerships with organizations with large field presences, through partnerships with national governments, and perhaps by making impact at a specified scale a pre-requisite to winning all or a portion of the prize.

Another theme that emerged was the importance of community involvement. The needs of communities, citizens, and end-users should play a role in the prize process in several ways. These include helping or playing a driving role in identifying needs, and the goals and the parameters of the prizes. Some prizes themselves might also have community groups as competitors, provided the competition parameters and possible accompanying grant structures were appropriate.

Funding, of course, will be needed for the realization of this approach, not only for the prize purses but supporting the overall operation. But more importantly, success on any of the elements will require appropriate partnerships (with each element often requiring different partners). As stated by a participant, “innovation is often collaborative and multidisciplinary.”

One of questions that arose was whether prizes could be designed to address simultaneously multiple issues (e.g., economic, environment, and social), since multiple dimensions are important in sustainable development.<sup>3</sup> There also was widespread of recognition of the fact that there is a paucity of collaboration between initiatives between various places and various organizations. Promoting collaboration between a range of actors from various area and various sectors (academia, large and small private firms, bilateral and multilateral agencies, and foundations) may

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<sup>2</sup> Associated activities can include educational programs, awareness-raising events, and overall profile-building to create and sustain broader interest in this area. For example, the Progressive Insurance Automotive X PRIZE (PIAXP) involves a set of competitions, programs and events, including an educational program, funded by a \$3.5 million grant from the United States Department of Energy, to engage students and the public in learning about advanced vehicle technologies, energy efficiency, climate change, alternative fuels, and the science, technology, engineering, and math behind efficient vehicle development.

<sup>3</sup> Of course, we may find that sometimes the relationship between these dimensions is synergistic, and sometimes competitive. For example, energy access and food security impact each other and have trade-offs. We can solve some agricultural problems, but if done inaptly, we would be adversely affecting the water situation or the livelihoods of those on the land.

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itself be seen as one of the desired outcomes of the award, and therefore integrated into the prize design. This could, for example, take the shape of several often competing organizations collaborating on a prize, or by requiring each competing team to have cross-sectoral participation. Or as a participant said, “we almost need a prize for a new way of working together.” But it was also recognized that organizations are more used to competition than collaboration, so the tension between these will need to be managed. But in the end, if one is able to build collaboration,<sup>4</sup> it may have long-term gains in terms of capacity building -- and as another participant noted, “capacity building may be more valuable than technology.”

This approach also gels well with the emerging focus on results-based financing, especially given the increasing pressures on aid and philanthropy because of the global financial crises are forcing these groups. Prizes are starting to be one of the tools in this box, but this could be combined with other tools (such as Advance Market Commitments (AMCs)) to ensure widespread impact. While this scoping exercise was at the global level, the prize approach could be applied at the national level, or at a much more local level. In fact, it was suggested that a diversity of approaches may be of benefit (and may also attract a larger variety of partners).

In fact, given that some of these innovation prizes are intended to catalyze a paradigm shift, it would be useful to think about think explicitly about addressing issues of power, agency, and mobilization, which all are central to the development process. For example, could we get a prize to address power relations explicitly? Accountability? Transparency for governments? Mobilizing communities? We might also want to think about a process to get communities involved so that we have learning within the base of the pyramid. In fact, one could even imagine crowdsourcing possible ideas for prizes or aspects of the judging to enhance public engagement. A focus on issues of equity, and of communities in need – which might mean a focus on bottom income quintiles, or climate resilience in vulnerable communities, and of community input and driving of needs identification and prize goal setting - may be avenues to incorporate these key concerns.

In terms of institutional architecture of a ‘prize-centered innovation’ for development program, there was agreement that its needs to be nimble, entrepreneurial, and outside the multilateral system. At the same time, it needs to bring on board a large number of partners and stakeholders to ensure progress on each of the three elements of the prize process discussed earlier. Standardized

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<sup>4</sup> The prize process itself could be designed to enhance collaboration. One could, for example, specify that each team must consist of participants from different sectors.

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interaction guidelines (or a ‘certified’ MoU) may help in this regard, especially for organizations that are bureaucratic. This will help streamline the creation of partnerships and enhance agility. Some learning from the ‘open source’/‘open innovation’ experiences should be useful in this regard.

This process ought also to create a useful dialogue between civil society, governments, and private actors. In fact, if the prize is centered on an important issue, is able to bring together the key players, and excite them, that itself is a big move forward. The process should also be such that it can draw on expertise of the large number of individuals in a range of organizations – public, private, multilateral – who have lengthy experiences on development issues. As succinctly stated by a participant, “you don’t want to create more apparatus, but want to take ideas out of busy people’s heads.” To get serious engagement from institutions, they ought to put some ‘skin in the game’ – this will help ensure that they are real stakeholders from the beginning to end. Major institutions like the United Nations and the World Bank have enormous convening power, which could be leveraged to enhance the effectiveness of the overall process. It was also agreed, though, that many of the institutional issues will get sorted out only when one starts moving forward on concrete projects.

## **NEXT STEPS**

The next steps would be for X PRIZE to synthesize the learning from the workshops and associated conversations as well as other research and submit a report to DFID. This would inform DFID’s decision of whether to fund a program of prize-based innovation for environment and development.

The participants were overall very enthusiastic about prizes and about remaining involved as such a program moves forward. One suggestion, from Andrew Steer, was that the World Bank as a trustee of the Green Fund could have the Fund explore incentive prize-based mechanisms. He also noted that World Bank has a request from the G20 regarding climate finance mechanisms and ways to multiply the impact of climate finance, and that prizes are one such way. The UN’s Janos Pazstor was interested in exploring possibilities with the Global Panel for Sustainability. One party, after noting that these were early days and it was not completely clear what the final

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outcome of this exploration would look like, emphatically stated that, “I want in,” a sentiment that was seconded by others.

In the meanwhile, we will also continue to explore other avenues through which to take this kind of a program forward. One possibility would be to convene a funders’ roundtable in the January-February 2012 time frame, depending on the parties’ schedules, to be held in New York City or potentially Washington, DC, where we could discuss support for such a program with other funders (bilateral donors, private foundations, and individuals). At the same time, building upon some of the ideas at the workshop, we will continue to discuss and field input from parties on how to identify and prioritize potential high-impact prizes, and on how to structure and launch a prize platform.



## MULTISTAKEHOLDER MEETING ON INNOVATION PRIZES AND SUSTAINABLE DEVELOPMENT

**DATE:** July 20, 2011

**TIME:** 3:00—6:00 PM

**VENUE:** UNICEF House, 3 UN Plaza, 12th Floor Conference Room

**Introduction:** 3:00– 3:15

1. Greetings and objectives of workshop
2. Short introduction by each attendee

**Innovation:** 3:15–3:25

3. Innovation and Development

**Prizes:** 3:25–3:50

4. Prize-driven Innovation: Experience to Date  
& their Potential in the Sustainable Development Space

**Discussion #1:** 3:50–4:30

5. Roundtable: The Reaction. Responses to the Questions: What do you see as the key challenges and potential solutions in applying incentive prizes to development? What opportunities do you see for Prizes in your sectors and your work more broadly?
6. Perspectives from participants on video/audio links

**Break:** 4:30–4:45

**Discussion #2:** 4:45 – 5:45

7. Roundtable: Institutional Arrangements. Responses to the Questions: What would we need to create a multistakeholder platform for prize-driven innovation? Who could contribute what to make this happen?

**Wrap Up & Way Forward:** 5:45–6:00

**Drinks and Dinner Off-Site:** for those interested and available

PROGRAMME

JULY 20, 2011, NEW YORK



भारतीय प्रौद्योगिकी संस्थान दिल्ली  
Indian Institute of Technology Delhi

XPRIZE  
FOUNDATION



## PARTICIPANT LIST

### **ACUMEN FUND**

Rajan            Kundra            Deputy Chief Innovation Officer

### **WINTERHOUSE STUDIOS**

Bill (William)    Drenttel            Partner, Winterhouse Studios. President Emeritus of the American Institute of Graphic Arts (AIGA)

### **DFID**

Bryony            Everett            Consultant

### **FROG DESIGN**

Robert            Fabricant            Vice President, Creative

### **GREEN BELT MOVEMENT**

Peter            Ndunda            GIS Specialist

Stephen            Mills            Director

### **INDIAN INSTITUTE OF TECHNOLOGY, DELHI**

Ambuj            Sagar            Professor, Vipula and Mahesh Chaturvedi Chair in Policy Studies

### **OXFAM AMERICA**

Chris            Jochnick            Director, Private Sector Department

### **ROCKEFELLER FOUNDATION**

Michael            Myers            Senior Policy Officer and Director of Centennial Programming

### **SJF VENTURES**

Arrun            Kapoor            Managing Director

### **UN DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS**

Gabo            Arora            Adviser, MDG Advocacy Group, Office of the Under-Secretary General

### **UN SECRETARY-GENERAL'S HIGH-LEVEL PANEL ON GLOBAL SUSTAINABILITY (GSO)**

Janos            Pasztor            Executive Secretary, GSP

Katell            Leugeuven            Senior Advisor at GSP

**UN GLOBAL PULSE, SPU, EXECUTIVE OFFICE OF THE SECRETARY GENERAL**

Robert	Kirkpatrick	Director
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**UN WOMEN**

Tracy	Raczek	Focal Point, Climate Change and Sustainable Development
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**UNEP**

Maaïke	Jansen	Inter-Agency Officer
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**UNICEF**

Vanessa	Tobin	UNICEF Representative, Manila, Philippines
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James	Rogan	Chief, Risk Reduction and Recovery
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Michele	Ferenz	Senior Advisor, UN and Intergovernmental Affairs Governance, UN and Multilateral Affairs (GMA)
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Christopher	Fabian	Co-Lead, Innovation Unit, NYHQ
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Kerry	Constabile	Specialist, Environment
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Caroline	Howe	Consultant
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**US FUND for UNICEF**

Rajesh	Anandan	Senior Vice President
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Carolyn	Weidemann	Director, Public-Private Partnerships
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**USAID**

David	Ferguson	Deputy Director Science and Technology
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**WORLD BANK**

Andrew	Steer	Special Envoy for Climate Change
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Dan	Kammen	Chief Technical Specialist for Renewable Energy and Energy Efficiency
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Oliver	Knight	Senior Energy Specialist
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Yuvan	Beejachur	Counsellor, Office of the Special Representative to the UN
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**X PRIZE FOUNDATION**

Christopher	Frangione	Senior Director, Energy and Environment
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Jaykumar	Menon	Senior Director, Education and Global Development
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# PARTICIPANT LIST

## Via PHONE

Morgan	Bazilian	Special Advisor to the Director-General on Energy, Climate Change	UNIDO
Julian	Ugarte	Founder and Director	Un Techo Para Chile

## Via VIDEO

Debora	Comini	Deputy Regional Director of Latin America and Caribbean Region Office	UNICEF
Herve	Peries	Regional Planning Chief West and Central Africa	UNICEF

**EXHIBIT 3:**  
**BIOGRAPHIES**

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## AUTHOR BIOGRAPHIES

**Jaykumar Menon**, Senior Director, Education and Global Development, X PRIZE Foundation

Jaykumar is an award-winning international human rights lawyer, an entrepreneur, a former McKinsey consultant, and an adjunct professor at McGill University. At the X Prize Foundation, he is exploring prizes in water, clean energy, hunger, infectious disease, education technology, and other areas, and is also leading the opening of the Foundation's office in India - its first international expansion.

As a lawyer, working with the Center for Constitutional Rights, and alongside community activists and private investigators, Jaykumar has represented the student leaders from Tiananmen Square against Li Peng, the former Premier of China; helped win a \$4 billion judgment on behalf of victims of the Bosnian genocide against Radovan Karadzic; represented the family of the executed Nigerian environmental activist Ken Saro-Wiwa against Royal Dutch Shell; freed a man from death row in Indiana; and as the fifteenth lawyer to take up the case, hunted through the prisons of New York to help track down the real killer and free a man named David Wong who had served 14 years of a life sentence for a murder he did not commit. Jaykumar has also helped represent several developing country governments in their dealings with the international economic system. As a scholar (an adjunct professor at the McGill Institute for the Study of International Development, and a Research Fellow at the McGill-based Centre for International Sustainable Development Law), he has written articles in leading international law reference books and law journals, including those published by the Oxford University Press. As an entrepreneur, he co-founded a venture-funded Internet company with current seven-figure revenues. He is also a published creative writer, and has contributed a short story to an anthology that collectively won the American Book Award, and served as an editor of a book published by McSweeney's. Jaykumar studied at Columbia Law School (J.D.), Brown Medical School (completed one year, as a member of the Program in Liberal Medical Education), the Columbia School of International and Public Affairs (M.I.A.), and Brown University (B.A., National Merit Scholar). He hopes to creatively effect large-scale and just social change.

**Ambuj Sagar**, Dean, Alumni Affairs and International Programs, and Vipula and Mahesh Chaturvedi Professor of Policy Studies at the Indian Institute of Technology Delhi

Ambuj's expertise and interests lie in science & technology policy, environmental policy, and development policy, with a particular focus on the interactions between technology and society. While his current research focuses mainly on energy innovation and climate policy, he also studies, more broadly, various facets of technology innovation, environmental policy politics and processes, and engineering education and research. His recent papers have dealt with energy innovation policy and strategies (in areas such as biofuels, coal-power, and automobiles), climate change policy, and capacity development for the environment. He has worked with various agencies of the Indian Government, with international organizations, as well as with other private and public-sector organizations in the US (including as a staff researcher for a major study on energy R&D for the White House). He currently is a member of the Indian Planning Commission's Expert Committee on a Strategy for Low-Carbon Inclusive Growth as well as a member of the India-US Track II Dialog on Climate and Energy.

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Ambuj is one of the original proponents of the concept of Climate Innovation Centers, a concept that has been introduced into the climate negotiations by the Indian government and has found traction within the negotiations as well as amongst various agencies including within the Indian government as well as the World Bank. He also has played an instrumental role in the design and launch of the Indian National Biomass Cookstove Initiative which aims to develop next-generation cookstoves (in partnership with the X PRIZE Foundation) and deploy it to the estimated 160 million households across India that do not have access to modern cooking energy.

Ambuj did his undergraduate studies in Mechanical Engineering at IIT Delhi and subsequently received an M.S. in Aerospace Engineering from the University of Michigan as well as an M.S. in Materials Science, a Ph.D. in Polymer Science and Technology and an M.S. in Technology and Policy from the Massachusetts Institute of Technology. He was a Senior Research Associate at the John F. Kennedy School of Government and Assistant Dean for Strategic Planning at the School of Engineering and Applied Sciences at Harvard University before joining IIT Delhi in 2008.